

The Journal
OF THE
Royal United Service Institution.

VOL. XXV.

1881.

No. CXIII.

Friday, May 27, 1881.

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Chairman of the Council, in the Chair.

MILITARY COLONIZATION AS A RESERVE FOR INDIA.

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"Res dura, et novitas regni me talia cogunt
"Moliri, et late fines custode tueri."

THE subject which I am privileged to bring under your notice to-day is no new idea: I cannot claim originality in its conception; nor can I truly assert that most of the arguments to be adduced have not already been discussed and sifted by far abler hands.

The colonization of the Himalayan and other mountain ranges of India; the establishment thereon of more sanatoria; and even the planting of "*Military colonies*" has for years past been counselled by several men of mark; and their arguments in favour of such a step have been various and strong: "Reduce"—say these advocates—"the strategic points in the plains to a minimum, and locate the bulk of your British troops in the mountain ranges." Sanitary statistics indubitably point to this as an act of wisdom; and I hazard the suggestion that it may possibly be found equally wise in a political and strategic sense. I have myself formerly advocated such a view of the question, and in drawing up the present paper must be pardoned if I here and there borrow my own words on this subject.¹

2. On reference to a "Lecture delivered at the Branch United "Service Institute for India, at Darjeeling, on the 30th October, 1872," I find I have instanced the Colonial systems of *Spain* and of *Portugal*—also of the Romans in Britain—as historic studies approaching the

¹ Vide Nos. 10 and 12 of the "Journal of the United Service Institute of India, "1873," on the "Strategic Value of Cashmere," and "On the Colonization of the "Mountain Ranges of India."

condition of British India as parallels; but although they have some points in common, the attempt to infer the future of India from the analogy of history is not valid, and has been deprecated. We stand alone in the experience of nations as regards British India, and no parallel exists in the history of the world from which to draw an inference as to its future. We must, therefore, evolve for ourselves and from our own prophetic forethought the idea of a "future India."

It is the object, therefore, of this paper to attempt a closer investigation of the probable bearings of this important question; and, first, it may be convenient perhaps shortly to review the opinions of a few able men who have made this question their special study.

Up to 1813, the opinion obtained that "a large influx of Europeans into our Indian territories must prove dangerous to the peace and security of those invaluable possessions."—*Letter of Court of Directors, H.E.I.C., to Lord Liverpool, dated 27 May, 1813.*

After this, however, a decided change in the views of the Indian Government seems to have taken place, for in 1829 we find Sir Chas. Metcalfe recording his opinion "that it is a matter of regret that Englishmen in India are excluded from the possession of land and other ordinary rights of peaceable subjects," and he expressed his belief that these restrictions impeded the prosperity of our Indian Empire.

Again, in 1830, Lord W. Bentinck says, "I feel most anxious that the state of the law should be so amended as to oppose no obstacle to the settlement of British subjects in the interior."

In 1832, when the parliamentary discussion on the renewal of the H. E. I. Company's Charter took place, we find our tenure of India compared to a "gigantic tree, its trunk and branches of vast strength, but resting merely by the pressure of its superincumbent weight, instead of having shot its roots into the earth!" Hence clearly recognizing the fact of our having no real grasp on the soil. Again, our Indian Empire is compared to a "Titan with arms of iron, head of brass, legs of oak, feet of clay. The giant's feet of clay his weakest part, and the first great storm may lay him low!"

What does this point at, but a want of a grasp on the soil in other words, of *colonization*?

The hackneyed simile of the "inverted pyramid" has often been applied to our tenure of India.

Metcalfe wished to colonize India.

Malcolm says "India is as quiet as gunpowder," and proceeds to urge its colonization.

Lawrence (Sir H.), as long ago as 1844, in his Essay on "The Military Defence of our Indian Empire," advocated partial colonization, especially for *military* settlers. To quote more modern opinion, I may add that *Campbell* (Sir G.), in his work "*India as it may be*," enters upon this subject and advocates colonization. He says, "I would have Government to encourage hill colonization to the utmost, and especially to hold out inducements to its servants to settle in the country."

Such, then, are a few opinions favourable to the general scheme

of colonization of India; but I would go a step further, and advocate *Military Colonization*.¹

I am aware, however, that the very idea of a *Military Colony* is so distasteful to the political ideas of the present day that I prefer the term "*Sanitary*," or, better still, *Industrial "Circles"* as the appropriate designation of the Military settlements I purpose to bring forward for discussion.

3. Now I hope I may be considered "*in order*," and as not wishing to offend the susceptibilities of any, when I remark that the "European Colcnist," the "*interloper*," as he was called, hasal ways been regarded as an objectionable being in the eyes of an Indian Government. We know that it takes a full generation to kill a prejudice. Men, otherwise sound and far-seeing, are apt to cling to the prejudices of their early manhood; and, as advisers, are inclined to apply the traditional drag on progress, perhaps too freely at times. The traditions of the old East India Company still survive, and their sins of omission in this respect, and obstructiveness to European settlement and enterprise, have taken too deep a root to be easily eradicated. It has always appeared to me that a great opportunity was lost, as a mitigation of the dilemma of the Indian Staff Corps, "with its vast burden on the revenue," to which the State was committed, in not encouraging surplus Officers and time-expired soldiers, discharged at the time of pressure, to volunteer for a "*Reserve*" for India, granting them perhaps land *in fief*; it being understood that *fief*, or fee simple, is "*that which is held of some superior, on condition of rendering him service, in which superior the ultimate property of the land resides.*" It is suggested for consideration whether military "*circles*" might not perhaps be thus inaugurated, as one means towards the formation of a "*Reserve Force for India.*"

4. A Russian gentleman once remarked to a friend of mine: "You need not expect to continue to hold India unless you follow our example, and colonize;" and, indeed, the want of a "*Reserve*" seems manifest. I would speak with the respect and diffidence becoming an old soldier; but the absence of a "*policy*" on that point inspires distrust.

At any rate I would advocate anticipating the march of events, and getting as much of the mountain soil of India as possible into our own hands, and occupied by our own colonists, bound to us in military fief, before private enterprise shall have stepped in and absorbed the mountain tracts, and so in the end creating those very political complications apparently apprehended (if we may judge by the old exclusive policy) as involved in the land settlement of colonies whose citizens are not *sub vexillo*; and foreshadowing an *imperium in imperio*, antagonistic to the interests of the State.

As regards the objection that British colonists would supplant the natives, it may be remarked that colonists would bring their wealth

¹ Since delivering this lecture I have heard it stated that "there are records that Clive, Warren Hastings, Wellington, Munro, Bentinck, Metcalfe, Ellenborough, Dalhousie, Malcolm, Canning, and the Lawrences, amongst others, have favoured "the occupation of the hills." (HYDE CLARKE, V.P.S.S., &c.)—D. F. N.

and capital, and so renovate the land, which has hitherto been rack-rented to maintain an alien race; and the vitals of the revenue sapped to support the expensive machinery of an exotic government. We should thus be restoring to India a portion of the wealth extracted therefrom. "For at this day we find a country drained of its wealth "by men who are discouraged (if not actually prohibited by law) "from applying any portion of their gains to fructify the soil whence "they are extracted." Some day, as a means of fomenting rebellion, an enemy might point to the fact of our revenue being spent out of India, and the country thereby drained of its life-blood.

5. The Report of the Parliamentary Committee of 1858, on "the "best means of promoting European colonization and settlements in "India, especially in the hill districts and healthier climates of that "country," as well as for "the extension of our commerce with Central Asia," embraces Dr. Martin's Sanitary Report, Dr. Hooker's "Report on Sikkim," and Captain Ochterlony's "Report on the Neil-gherries and Malabar Hills."

It appears, however, a good deal hampered by local and partial developments, and refrains from definite recommendation of a policy for the State on those points. One of the results, however, seems to have been the collecting by Government officials of returns of "waste lands" available for settlement.¹ They are chiefly taken from the

¹ TABLE OF WASTE LAND (1861).

District.	Total acres.	Remarks.
Punjab, upper parts (3,000 elev.) favourable for European settlement	7,626,785	
Trans. Indus Highlands, Kohát Házára (16,479), may now be estimated	4,000,000	
Mooltan (district) suitable for indigo, &c.; hot and arid	1,510,388	
Himalayan States, Simla (Keyonthal), 5,676, 15,000; (districts 6,000 elev.) ..	20,676	
Kangra, waste land	16,136	{ Leased out and embarrassed with village grants.
Hooshiarpore, waste land	15,000	
Dehra Doon	204,526	
Darjeeling	250,000	
Kumaon and Gurhwhál	500,000	Approximate.
Assam, Kamroop (179,500), Cachar ..	5,000,000	Culturable, besides thousands of square miles of forests.
Damon-i-Koh (Raj Mahal)	675,840	
Madras, culturable lands (mamool) ..	13,554,333	
Bombay, Northern	1,635,666	
" Southern	2,000,000	Conjectural.
Scinde frontier	2,028	
Tenasserim provinces	628,034	
Pegu	13,146	
Mt. Aboo. Land leased to village communities	Nil.	
Mysore, table land	2,644,306	
East Berar, and the Sathpoora range ..	200,000	

special reports of 1861, and will serve to show the vast areas of waste or culturable land in India, at the disposal of the State for purposes of settlement. Some of the sites, however, are scarcely in climates adapted for *European* colonies, though others included in the larger figures are so, such as the Southern Mountains, and Khassia Hills.

6. "The Report on the Sanitary Establishment of European Troops in India (1861)," and the "Memorandum on the Colonization of India by European Soldiers (Punjaub Reports)," does in some sort deal with this question of Military Colonization; and a writer in the "Calcutta Review" founds thereon a definite scheme of colonization. He even lays down the precise force that would result from the scheme, and it may be roughly stated at an accession of strength to Government of a Reserve of 10,000 infantry, 700 cavalry, and 72 guns.¹

I have only recently met with this scheme, and it has been gratifying to me to find my own views corroborated—I may say, forestalled—in this, as in some other instances, from perfectly independent sources.

7. The mention of Military Colonies leads to that of Hill Convalescent Depôts or Stations. There is an obvious connection between them. Except in the matter of *cultivation* of land; the real attribute of a *colony* (from *colere*—to cultivate), and other industrial avocations; a hill sanitarium might be made closely to approximate in its character to an *industrial circle*, such as I advocate. The garrison of the depôts as at present constituted is constantly changing, as the convalescents recover health they return to their corps; but were such garrison composed of veteran or time-expired soldiers, enrolled *sub vexillo*, as volunteers for such colony—with grants of land to Officers and men—*mutato nomine*, you have the elements of a *Military Industrial Settlement*.² In the sequel this especial development will be more fully

¹ The following is a summary of the Colonies (or *Regiments*, as the Reviewer calls them, vol. xxxvi, p. 220, *et seq.*, of 1861), suggested:

Punjaub, Kohisthán	3 regiments reserve.
Kangra	1 " "
N.E. States of Punjaub	1 " "
Total	5 regiments for Punjaub containing 3,500 men of all arms.
Simla	1 regiment.
Dehra	1 "
Darjeeling	1 "
Rajmahal hills	1 "
Madras Presidency	2 "
Bombay "	2 "
Total	12 or 13 Colonies containing 10,000 infantry, 700 cavalry, and 72 guns.

² The author's former lecture on this subject, dated 30th October, 1872, was delivered whilst at Darjeeling in command of the Hill Depôt there; and perhaps his views may have been coloured by that fact.

He had sketched a plan of an industrial farm in connection with that command.

touched on. Meantime, I hazard the question: "*Could a Hill Sanitarium be expanded into such a Colony, and industrial pursuits developed in connection therewith, so as eventually to fulfil the conditions "adverted to, of a self-supporting Colony or Reserve Circle?"*"

Apart from their value as absorbing surplus industrial energy, and perhaps (when opened to volunteering) much of the floating vagrancy of the State, such colonies would naturally be amongst the means of securing a strategic grasp on the soil of India; affording as they naturally would do the nucleus of a *Militia* or *Reserve Force* to supplement the regular army; and, in conjunction with "entrenched camps" at the strategic points, would form rallying-points or refuges for the non-combatant portion of our nation in case of popular revolution, and would immensely strengthen the hands of Government.

Military Asylums are (or could be made) similar in general features, and might, perhaps, be considered as Military Colonies *in statu pupillari*; and might even be affiliated with such colonies, and the whole included within the protection of entrenchments, such as have been alluded to.

8. I observe that in a former lecture from which I have quoted (dated 30th October, 1872), I have enlarged on this special subject of "*Entrenched Camps*," or Refuges, remarks with which I need not trouble the present audience.

I would simply repeat that such works were strongly advocated by such authorities as the late Sir Charles Napier, Sir Henry Lawrence, and others; and I do not see why such purely military works should not in a great measure be thrown up by British soldiers, especially in the hills, where, in fact, strong working parties of various regiments do annually hut themselves, make roads, and generally enact the part of pioneers in ground selected for their summer encampments. To see the robust, rosy appearance of such men, instead of the washed-out faces one sees in the plains of India, is very cheering. I would ask, also, What more honourable employment for the British soldier than thus to construct works of grandeur and utility, such as the Roman soldiery have bequeathed to posterity as imperishable works on their native soil, as also, indeed, on the soil of this our Britain, whose occupation by Romans for several centuries bears a considerable historic parallel in some respects to our present occupation of India?¹ Should we eventually relinquish our great Indian dependency, British soldiers might thus point to something greater than the traditional pyramids of empty beer-bottles formerly attributed to us as a reproach.

If, moreover, the colonization of our splendid ranges of mountains be inaugurated; Military Colonies (or *Reserve Industrial Circles*) fostered;

and was on the point of submitting his plans to authority, when his term of command expired. As it was, he can attest that several of the Non-commissioned Staff and others realized considerable sums of money by raising stock, curing bacon, &c.

The draft of this sketch is at hand, and the questions raised in it might be reproduced perhaps for discussion with advantage, would time and space admit, as a suggestion for the industrial development of a Hill Depot.

¹ Cæsar landed in Britain, B.C. 55, and the last Roman soldier left the country A.D. 426. The occupation of Britain, therefore, by the Romans lasted more than 450 years.

English settlers of capital and enterprise encouraged, and the other obvious means of obtaining a grasp on the soil of India carried out; we may find the India of the future fulfilling the condition of a self-protecting colony; a consummation, perhaps, hereafter devoutly to be wished by England, in case of war; when instead of a degenerate population such as some of the South American Colonies of Spain present to us at the present day, we may hope to find citizens of pure Anglo-Saxon type, as the National garrison of India: able and ready in alliance with gallant native *auxiliaries* to face a world in arms.

9. *Politics* are I believe prohibited in this assembly, I might otherwise perhaps venture on speculation as to the *Future of India*, a deeply interesting subject. I might ask, Is our national flag *India* for the *English*? or *India* for the *Indians*? I would rather hope we may be able to say, *India* for the *Empire at large* and *Humanity*. By degrees, no doubt, the two races may be welded into a common interest, and a *grand National Army* for the general defence of the Empire, as attempted to be shown, created, both *Regular* and *Reserve*.

As regards the planting of colonies, I would not exclude our *Native* soldiery. Colonies of *Sikhs*, *Dogras*, *Goorkhas*, and other warlike races might be planted in certain sub-alpine points with advantage¹, the experiment has been tried in the case of *Goorkhas* with considerable success. *Russia*,² *Austria*, *Persia*, *French Algeria*, are examples of nations who have planted *military villages* as one means of holding a frontier against savage neighbours, as I have pointed out in a paper on the "*Defence of our N.W. Frontier*" (in No. 10 of the *Journal U.S. Institute for India*), where I instanced the *Gunze* or *Ganz* regiments of the Austrian frontier as a case in point; originally organized as a *cordon sanitaire* against that fell enemy the plague, at that time threatening an advance into Europe, they were retained after their special object had been fulfilled.

But, indeed, history is replete with such instances. We know what a success the *Roman Military Colonies* were: veritable *propugnacula imperii*: These colonies were cities or lands which Roman citizens or soldiers were sent to inhabit.³ One-third of the land was ordinarily

¹ Perhaps in "India Alba," our newly acquired trans-Indus territory, which I have treated of in Section 16 of a work on the "Highlands of India," presently to be mentioned, I am treading on delicate ground; but the alacrity with which Russia has found an opportunity for a *congratulatory* mission to Abdûl Rahmân of Cabul is remarkable.

² Let us not forget that Russia is a *colonizing* as well as *conquering* Power. I would pause to say how interesting are some of the accounts one reads of Russian regiments or batteries—chiefly Cossacks—settling down on conquered lands in Siberia and elsewhere. Cut adrift from their supplies, they hut, clothe, and supply themselves with food by hunting, fishing, &c., besides agriculture and other pursuits of the Colonist. What a field for individuality! Such an expansion of Military life is indeed attractive! Could it ever be ours? Carrying with them their loyalty and cultivation—military and mental—into the wilderness, these able officers of Russia are true patriots, and they carry their country's flag into new regions of the earth; fulfilling, also, the idea of a (Roman) colony *sub vexillo*.

³ The Tartar quarters of Chinese towns were evidently originally camps or citadels of the conquering race, antecedent to the times when the races became fused into a Chinese nationality.

set aside for the garrisons, which (in the times of the Empire) often consisted of an entire legion bodily settling on its garrison lands; but in ordinary cases a colony was led forth *sub vexillo* (which may be rendered "colours flying") by officials, triumvirs, ordinarily three in number, and the land was then and there ploughed and allotted to the volunteer colonists. These were essentially *military colonies* fostered by the State, and proved the salvation of the Empire for a time. On the other hand, the Greek colonies (as also, indeed, the North American Colonies of England, afterwards the United States of America) are standing examples of what colonies should *not* be—namely, settlements of disaffected citizens, who afterwards became bitterly hostile, and even subversive of the parent State. Is no moral to be drawn from such examples?

This, I think, forms an additional argument for *military colonization* and *volunteer corps*,¹ and with this in view it would seem advisable to get some more of the waste lands of India settled by tenants of the State bound in fief to defend the land; the definition of fief, or fee simple, being, as already stated, "that which is held of some superior" "on condition of rendering him service," in which superior the ultimate property of the land resides.

10. I am bound to say, however, that arguments on the other side are not wanting: amongst them the necessity of a *seaboard* has been urged, and the *contact of ocean* insisted on as the necessary nurse of social infants, such as the proposed colonies have been termed: and predictions have not been wanting that colonies if planted in the Himalayas would soon be merged in the darkness of the semi-barbarous tribes around them, and so be lost in Cimmerian mists.

To these opinions I must demur, believing as I do that in these days railways could bring the "arts of war and peace" and civilization to their very doors if desired; and practically bring the seaboard as near to Himalaya as Ostium to Rome or the Piræus to ancient Athens.

11. It has also been urged that the culture of Indian land by Europeans *would not pay*. To this I would remark that the culture system of *Java* as introduced into that colony by the Dutch, in 1830, would seem to point to a development of the "Crown lands" of India (where they exist) well worthy of study: my treatment of this subject as a *militaire* must necessarily be crude and curt: suffice it here to say, that the revenue of *Java* was within the thirty years succeeding its introduction *quintupled*, and the happiest relations established between the European and the Native, and especially natives of rank were employed as helps to the scheme. To enter on details would, however, occupy too much space, and after all only bears indirectly on the question before us. Suffice to say, that by protecting the interests of all concerned, and cultivating with valuable products over and

¹ The Carthaginian colonies on the Mediterranean seaboard, which afforded such vast levies to Hannibal and his army during his wars against Rome, need not be cited as instances in history of military colonies aiding the mother country.

Rome had colonies on her military frontiers, both on the Rhine and Danube; in Gaul and in Dacia; also in Britain. London itself was a Roman military colony.

above the rice lands required for the food of the villagers, by contracts with capitalists, and, lastly, giving both the cultivator as well as the superintending officials, European and Native, a percentage on the outturn, the Dutch Government seems happily to have solved the problem of remunerative culture of its colonial possessions, and the European is protected from fraud and the Native from violence and force. "How different from the cultural state of India abandoned by us to the law of supply and demand, and the unprotected and uncontrolled principles of political economy! and the advanced doctrine of unrestricted enterprise. In such a race the European, following his instincts, resorts to force, and the Native, equally following nature, to fraud, and such scandals as we have heard of in 'indigo' planting, &c., have been the inevitable result. Government, in fact, shrinks both from taking the law into its own hands, and so guarding all parties, the cultivator, the village community (or landlord as the case may be), the contractor, and, lastly, itself as suzerain entitled to *fief* in labour or land, as also from encouraging the increased European supervision necessary to the development of any culture system such as that of *Java*. Yet the Dutch have introduced such with the happiest result. By supplying European energy with the deserved Government advances on private capital, the cheap labour of India could not fail to render the cultivation of cotton, sugar, flax, indigo, tea, coffee, tobacco, highly remunerative to all concerned." On this point the study of the Dutch land culture system could not fail to be instructive to all men in authority on the Indian establishment. The details are to be found in Money's "*Java, or how to manage a Colony*" (1861). I have quoted and enlarged on this particular development of the waste land of India, because I should think it might be happily imported into the working of the military colonies, or industrial circles, advocated in the present paper.

A means also of increasing the revenue of India is thus indicated: but the question now occurs, "By whom is such a system to be worked?" Not, certainly, by individual hardy soldier colonists, (except under strict martial law), whose best field resides in the struggle with the powers of nature such as are found in the rude climes of America, Canada, and the Australian colonies. The hills of India, however, present a somewhat analogous climate to the private settler with capital, and the energy and strength of the Anglo-Saxon might, perhaps, be thereby utilized in the struggle with the forest and the field: but to *direct* labour gentlemen of education and habits of discipline and good sense, such as army officers and volunteers from overstocked professions in England, are required rather than men of coarse Anglo-Saxon self-assertion, with contempt for 'niggers,' &c.

"With this reservation the Alpine fir-clad slopes of the Himalayas, and the ever verdant plateaux of Central and Southern India—vales bathed in perpetual spring," cry aloud for population.

Some further arguments in favour of colonization are suggested by a perusal of "*The Report on Colonization, Commerce, Physical Geography, &c., of the Himalaya Mountains and Nepal,*" by B. H.

Hodgson, Esq., M.R.A.S., B.C.S., some time Resident of Nepaul. He urges several points, as follows :

- (1.) A variety of climate in gradation of height from the plains to the snows ; with choice of elevation. A cultivator could have his dwelling at 4,000 or 6,000, and his farms either higher or lower, yet close to his abode.
- (2.) Himalayas eminently healthful.
- (3.) Rainfall at Darjeeling 130" (since less).
 " at Khatmando in Nepaul, 60".
 " at Simla, 70".

During 40 years, cholera only twice appeared in Nepaul. At Darjeeling, scarcely ever. Temperature at Darjeeling 60° to 65° from June to September, and in winter the same temperature reduced in regular ratio of 3° for every 1,000' of elevation.

Sheep farming is a feasible project ; samples of wool sent to Europe commanded 7d. to 9d. per lb.¹ He enters on further particulars too long to be quoted, ending his remarks by saying :—

"Colonization is the greatest, soundest, and simplest of all political measures for the stabiliation of the British power in India. . . .

"With the actual backing upon occasion of political stress and difficulty of some 60,000 to 100,000 loyal hearts of Anglo-Saxon mould, our empire in British India might safely defy the world in arms against it."

12. As regards the planting of military villages, it is understood that some such scheme was formerly initiated in some of the larger British Colonies—Australia, New Zealand, &c.—and grants of land were made to retired Officers, both of British and Indian forces, but I never heard that veteran non-commissioned officers or private soldiers were in any way associated with them ; and the scheme never got beyond the crude inception, and never in the least degree foreshadowed the coherent idea of national colonies tending to the formation of a *Reserve force*. In view, however, of certain obvious contingencies, many Officers of foresight and experience have thought that India especially may ultimately have to revert in some sort to a local army, modified, perhaps, but still the nucleus of a *Reserve*, in case of war in Europe, otherwise it might well happen that India would prove a source of weakness rather than of strength to England. In such a contingency, what better resource to fall back on than a *Military Reserve* in the Himalayas and other mountain ranges ?

13. Closely associated with the question of *Military Colonies* is that of the nature of the force requisite to garrison the India of the future.

Now troops for the defence of a State may be classed as :—

- (1.) Native (British).
- (2.) Mercenaries.
- (3.) Auxiliaries.

¹ The whole of the table-land of Thibet is no doubt a grand wool field ; and its development might form one of the collateral projects of Himalayan "Industrial Circles."

(1.) As regards the first class—British troops. The general purport of this paper is how to supplement the present British mobile garrison by a *Reserve* or *Militia*, in other words a local territorial army; it finds its advocacy in the preamble.

(2.) As regards the *Mercenary* system. Under its old aspect it has broken down by the mutiny of 1857, and that great standing danger to our British Empire in the East, so apprehended by men like Malcolm and Metcalfe, has been in a great measure swept away; and in regard to its partial resuscitation by our present large Native Army, we may inquire: "*In what light must we regard our Native troops?*" Surely scarcely as "*mere mercenaries!*" Are not their interests yet sufficiently identified with our own to justify our calling them a "*National Army?*" I think so, and I would therefore, as, indeed, has been already suggested, associate them with ourselves in the experiment of *Industrial Reserve Circles*, which it is the object of this paper to discuss.

(3.) The third class of troops. *Auxiliaries* have scarcely yet been tried. The idea of small contingents or brigades to be furnished by certain Native Princes to co-operate with the regular forces of the State has scarcely ever been tried, though, indeed, of late a few thousand Sepoys of the Sikh Princes of the Cis-Sutlej States did take the field as a support during the late Afghan War, a happy precedent, as I think. To quote my own former words:—"I know not whether the day may have yet arrived when our great feudatories such as Cashmere, Patiala, Scindia, and others, should be entrusted with the independent maintenance of recognized *Corps d'Armées*, as portions of the grand Imperial Army of India. They exist as a fact; might it not, therefore, be well to call them out occasionally as auxiliaries for exercise with the Regular Army? By this means, possibly a portion of the British troops might be released from service as local custodians, and advantageously massed in healthy localities, such as hill districts, elsewhere. This leads me to reassert the postulate already put for consideration, viz.: The hills for European; the plains for the Asiatic soldiery! And the strategic points occupied and prepared as refuges or entrenched camps, as a rule, in the close vicinity of the industrial circles which would partly constitute their garrisons."

14. I might here dwell on our just claim to the services of our Native feudatories, whose integrity we guarantee from foreign and domestic enemies: self-preservation demands that we should in these days bring under more effective control, not only the contingents, but the entire armies of those States, and a most popular measure it would be, I think; and a force thereby raised, animated with a chivalrous rivalry, and jealous of each other to an extent just sufficient to ensure their fidelity to the British Government, the palladium of their honour and distinction. I put this for consideration, for I believe a territorial auxiliary Native army might be organized, on some such principle, and the whole welded into a grand National army of India really formidable to our foes and sufficient to guarantee the safety of India against all comers.

Contingents of the armies of our allies, *not being our feudatories*, form

a different branch of this subject, which simply points to a *Reserve* or interior defence: I hesitate to give an opinion on such matters, which are beyond the scope of this paper: I may say, however, that battles have been gained ere now with the aid of auxiliaries¹—*Plassy*, for instance—but they must be our servants, not *masters*, as history so frequently gives us instances of in the case of allies called in to aid. “It is in *himself* and his own courage alone that a prince should seek “refuge against the reverses of fortune.” So said one who knew the world of men and nations!

15. *Reserve regiments* or circles have been mentioned, and elements of one such were sketched in the former part of this lecture whereby an accession of strength to the State was estimated at 10,000 infantry, 1,000 cavalry, and 70 guns, all European troops, as a result of one scheme of the kind.

An experimental idea was also suggested in a sequel to the lecture from which I have quoted as given at Darjeeling, 30th October, 1872, for the formation of three small colonies to contain 100 men each, the expense of which, so far from being a burden to the State, was set down as an approximate saving in ten years of 130,000*l*.

Could I obtain the consent of my able collaborateur on that occasion (Captain F. Henderson, H.M. 107th Regiment), I could almost wish to reproduce *in extenso* his able lecture, entering as it did into the actuarial aspect of this question. To that gentleman, as also to Dr. Ambrose, who kindly supplemented my original address with sanitary statistics bearing on the same question, I was indeed most grateful: and I feel that as regards my present lecture, all was then said in a happier form than that I have now been enabled to reproduce. The three lectures—(1) on the Political and Strategic; (2) on the Sanitary; (3) on the Actuarial Aspects of Military Colonization—are to be found in No. 12 of the Journal of the United Service Institute for India, and form a trilogy (so to term it) which with the subsequent discussions on the subject (when we had the advantage of several able opinions) put forth all I could collect on this, to my idea, important question.

16. Little excuse seems needed for entering on the sanitary aspect of the case, when we observe that Dr. (Sir J. R.) Martin reported to the Court of Directors, H.E.I.C., that in the forty years embraced from 1815 to 1855, a total mortality occurred amongst the British troops of 100,000 men, “the greater portion of whose lives might have been saved “had better localities been selected for military occupation in that “country.” Now each British soldier has been calculated to represent 100*l*. The State, therefore, in that item, lost 10,000,000*l*. sterling.

Such issues, moreover, are borne out by statistics mentioned in the able lecture I have alluded to by Dr. Ambrose, H.M. 58th,—the Medical Officer of the Depôt at Darjeeling,—and a most able Officer. Amongst his figures I find the death-rate of British soldiers’

¹ The Romans employed auxiliary troops, paid and often led by native kings. These troops drew *rations* and sometimes *clothing* from the Roman State.

The auxiliary State brigades suggested in the text find their prototype in these.

children in India for 1854 was 68·83 per 1,000; from 1864 to 1869 it rose to 94·41 per 1,000 in Bengal; and for the year 1869 was reserved "the unenviable notoriety of being the period in which 145·22 out of every 1,000 European soldiers' children fell victims to the climate: "speaking roundly, the children of our European soldiers, the very "large majority living in the plains, have in each year been all but "decimated."

As a *per contra* to this, the increased health and consequent lessening of the death-rate to 39·9 in the hills is given. Other statistics on this head exhibit a death-rate lessened by six-sevenths in the hills.

Dr. Bryden's report to Government on the employment of British soldiers at road-making in the Himalayas, chiefly in the Punjab Hills, during the term 1863-69, contains further proof, if proof were needed, of the salubrity of these mountains: it appeared that of the 2,500 men so employed, the death-rate was only *one half of what it is in the Army in England*. "But," asks Dr. Ambrose, "why go on multiplying "instances in proof of the wonderful salubrity of our hill climates? ". . . . The Royal Sanitary Commission to which I have alluded, "after hearing and weighing evidence given by such men as Lord "Lawrence, Sir Henry Durand, and Sir Ranald Martin, made the "following recommendation regarding the geographical distribution "of an European army in India:—

"1st. To reduce to a minimum the strategic points on the alluvial "plains; and to hold in force as few unhealthy stations as possible.

"2nd. To locate a third part of the force required to hold these "points on the nearest convenient hill stations or elevated plain . . " . . . and to give the other two-thirds their turn."

This recommendation has been in part carried out, but scarcely in the thorough manner stated; but instead *palatial* barracks have been erected in the plains, and the rate of mortality and invaliding amongst our British troops, notwithstanding all our sanitary reforms, is scarcely diminished. I think I could suggest one or two concurrent causes of this, but in this place such cannot be entered on, beyond saying that heat and *overfeeding*, and lassitude engendered by want of wholesome industrial work, are some of those causes.

17. Now, as regards the first steps to be taken towards the formation of an industrial reserve circle or colony, such as have been alluded to, should such be ever inaugurated.

Assuming that such colonies should be *sub vexillo* (under martial law) with a regular military commandant and staff, it remains to suggest what sort of man we should endeavour to secure for our military colonist. At the discussion of this question on the occasion to which I have referred, it was generally agreed that able-bodied men between 20 and 40, if possible married men, would be at the expiration of their first term of service the most suitable: Artisans, husbandmen, and stockmen, each man possessing some craft highly desirable, if not imperatively necessary.¹ Non-commissioned officers and men of

¹ Of 100 men, 60 to be labourers, 40 mechanics; and it was further suggested

good character to have the option of volunteering, and this volunteering should be accompanied by an offer of a free grant of land, varying in extent from 3 to 25 acres according to locality and the special industrial avocations of the projected colony, and I fear it must be supplemented by a grant in aid of money. I see 1,000 rupees (say 100*l.*) was fixed upon as the least sum to start the colonist on his legs. The details of the start would be too voluminous to be entered on in this lecture. The internal organization, interior economy, and the Government legislation and supervision would alone absorb more space than can be allotted in this paper, which is necessarily of an *introductory* character.

The undertaking would necessarily be at first of an experimental nature, and would doubtless require much patient thinking out and elaboration to reduce it within anything like practical limits: the following tabulated average, however, as drawn up by Captain Henderson, may be given as a rough estimate of the undertaking suggested:—

ROUGH ESTIMATE OF THE COST OF 300 SOLDIERS FOR A PERIOD OF 10 YEARS.

	R.	£
Approximate cost of 1 soldier, per annum	1,000	100
" " 300 " " ..	300,000	30,000
Approximate cost of 300 soldiers for a period of 10 years	3,000,000	300,000

ROUGH ESTIMATE OF THE COST OF 300 COLONISTS FOR A PERIOD OF 10 YEARS.

	R.	£
Cost of conveying 300 men to the hills, at Rs. 50 per head	15,000	1,500
Grant in aid of Rs. 1,000 to 300 men ..	300,000	30,000
Staff allowance for 3 Colonies at Rs. 1,000 per mensem each for 10 years ..	360,000	36,000
Contingent allowances for 3 Colonies, at Rs. 1,000 each per mensem for 10 years	360,000	36,000
Compassionate fund for 3 Colonies, at Rs. 1,000 each per mensem for 10 years	360,000	36,000
Arms, ammunition, accoutrements, clothing, &c., for 300 men for 10 years ..	150,000	15,000
Building Government offices and staff residences at 3 stations	150,000	15,000
Total ..	1,695,000	169,500

According to which estimate a saving of 1,305,000 rupees (130,000*l.*)

that the permission to marry to young soldiers on the completion of their first term of service might form a very strong inducement to volunteer as a military colonist.

in ten years would accrue on the profit side, leaving a respectable margin for unforeseen expenditure.

Captain Henderson concludes his instructive lecture by quoting the words of Sir Henry Lawrence, who has already been alluded to in the preamble of this paper, as an advocate of military colonization, and for my part I cannot but consider that it must commend itself to all well-wishers of the European soldier and his family. It is interesting also to observe how nearly Sir H. Lawrence, forbearing to go into details, hits off as it were by intuition about what the actuarial calculation corroborates.

It would be quite impossible in this *introductory* lecture to enter upon further details. The remaining space allowed must now be devoted to a cursory sketch of some localities adapted for the placing of such colonies as have been suggested.

18. The sentimental aspect of military colonies as affording pleasant homes for Englishmen in the East, and its moral advantages to the soldier, need not here be mentioned. Such, perhaps Utopian, ideas were introduced into my lecture on this subject in India; and (if I mistake not) were sneered at as visionary. Utilitarians as we English sometimes are inclined to be, we are, perhaps, too apt to regard our soldiers simply from a financial point of view, and to think of them as mere machines for war—food for powder in short—but after all they are *men*, and their value moral as well as material. It is believed that the philosophic soldiers of Germany owe much of their success to the full recognition of the Napoleonic maxim, that the “moral is to the material as 3 to 1;” and no doubt the probable improvement both in the physical and moral health of the soldier from military colonization scarcely admits of question. Setting aside humane views, is it not our *interest* to fortify the soul and spirit of the soldier, amidst the grand aspects of nature and the breezes of a temperate zone? I may, perhaps, be pardoned if I here quote my own former words, which I see annotated as “*Arcadia rediviva, the sentimental aspect of military colonies.*”

“Gazing on the charming landscape, perchance in fair Cashmere, or “green Kangra, on the grassy slopes and downs of the Neilgherries, “or even at this tea-growing ‘bright spot’ Darjeeling, the idea has “sometimes occurred to me that haply in this fair land may arise the “homes of a happy Anglo-Saxon population; perchance in times to “come of cheerful English homesteads amidst the orchards and sheep-walks of the north; or the tea and coffee gardens of the south in “which the Indian veteran might cultivate his plot of land, and rear “a healthy family, his robust sons growing up the future defenders “of the State. . . . Then, should the clouds of war arise and “danger to the State, I have pictured a robust and valiant citizen army. “—*The Reserve Force of India*—ready to descend full of health and “confidence on the foe! These ideas are perhaps Utopian, but after all, “why should some such future for the mountains of Hindostan “not be?”

I must not forget, however, that I am addressing a calm-judging audience on a practical question. I must refrain from such senti-

mental themes ; I need not to indulge in rhetorical platitudes but proceed to the strategic aspects of the question.

19. The occupation of a ridge of mountains forming the water-parting, whence issue the rivers which fertilize the adjacent lowlands, must at once strike the eye of the military critic as the true line of domination of the plain country embraced within those rivers.

There is one Hill country (were it ours) above all others, calculated both from its topographical features, as well as its geographical position, to afford flanking strategic value for "Military Colonies" such as I would advocate, viz., Cashmere.

This position I have sought to establish in a former paper entitled "The Strategic Value of Cashmere," in connection with the defence of our N. W. Frontier, and I suggested that the flanking value of that country as commanding the five Doäbs embraced within the five Punjab rivers was inestimable, and should form a prominent feature in any Imperial scheme of defence for the Punjab and N.W. Frontiers of India. If that position be conceded, it follows as a corollary, though perhaps with less emphasis than in the more marked case of the Punjab, that the mountains flanking the entire Gangetic valley, viz., the Himalayan watershed, whence issue the rivers that flow into it, must, in like manner, be the true crown of domination of the deltas embraced by those affluents, and therefore probably the true points for occupation by a dominant race, so numerically inferior *in partibus infidelium*.

Instance, that troops massed in Hill Stations between the River Sutlej and Jumna (*i.e.*, Simla and its circle) are free to march and deploy on the whole Cis-Sutlej States and N. W. Provinces, without the obstacle of an intervening river, as was instanced during the mutiny of 1857, when the troops there in garrison marched to the siege of Delhi.

Again, troops in the ranges of *Garhwhäl* and *Kumäon* should command the Doäb, through the Dehra Dun, as far even as Allahabad.

The group of Hill Stations represented by *Almora*, *Nainee Tal*, and *Raniket* should command Rohilkund, Oude, &c., as far as the Ganges.

Troops at Darieeling should command S. E. Tirhoot and Bengal as far as the River Brahmapootra, and so on. The principle admits of modification owing to local causes, but in its general aspect may, I think, be regarded as valid.

Here, then, are some of the localities on which reserve circles should be placed ; but no doubt there are many points in other parts of India equally available ; such as the Neilgherry plateau with the Annamallay and Palney mountains in the south. The Sahyoodria, or Western Ghats, in the west, and perhaps a few isolated blocks or summits throughout India, such as Mount Aboo, the Omerkantuk plateau, would do for smaller refuges throughout the land ; once let the principle of *Reserve Circles* be conceded, and many suitable localities will be found. The Khassia hills might be named ; Pachmari and a few elevated regions in Central India, in the vicinity of Seöni and Rajmehal ; and, should we retain our lately acquired territory across the Indus, perhaps

sites for *native* reserve circles or Colonies may be found in the Highlands of *India Alba*.

20. I have here the MSS. of a work which I have called "The Highlands of India," wherein I have attempted to describe somewhat in detail these and other localities which seem suitable for military occupation, most of which points during my lengthened service in the East I have had opportunities of visiting personally.

The index on the face of the map (now before the audience) comprises the majority of these highlands, and I have assumed 4,000 feet in elevation as the demarcation of the temperate zone, above which malaria, that dire foe of Europeans in India, ceases to be formidable, though still sometimes active even between 5,000 and 6,000 feet.

The work in question will embrace perhaps 250 pages or more, and is, of course, too voluminous to be entered on except in this cursory manner here; but should time allow, I may perhaps have the honour of reading a few extracts bearing on some of the localities I have named, and so on the general subject of this lecture.

I will now ask my audience to look at the map of India before them.

I point to *Cashmere* and the *Kohistán* of the *Punjaub*, which subtends the arm of the *Himalayas* called the *Pir Pinjal*, behind which lies the valley of *Cashmere*.

Were *Cashmere* ours, I would at once say: "Here is your main defensive *Refuge* and *flanking* strategic circle for the whole frontier of Northern India—the very bastion and fortalice of the land,"—and my reason for this opinion is that the country of *Cashmere* flanks the entire path over which any invader from *Afghánistán* could pass; as also covers the side doors towards which a certain rival Power is always creeping; on this head I cannot, I believe, do better than refer to the lecture I have alluded to on the "Strategic Value of *Cashmere*" (No. 10, "Journal of the United Service Institute for India"), from which I find I have quoted in the work on the "Highlands of India," now before me.

It has ever been my wish to associate my military diagnosis of this question—the *Defence of India*—with the military occupation of *Cashmere* as within the scope of a grand Imperial system of defence for British India; and I hold it should be *subsidised*, as it seems our treaty obligations bind us too tightly to free our hands in this matter. Doubtless our ally, H. H. The Maharajah of *Cashmere*, the son of an astute and (for an Asiatic Prince) a steadfast and reliable friend to the British Government, which set him on his throne, has hereditary claims on us—and sufficient *savoir vivre* to support our views in all ways. His interests and ours, indeed, are (or *should be*) identical. I will not dilate on this theme, which is, moreover, fully treated of in the paper quoted.

Failing this there are sub-Alpine spurs and ranges in the *Kohistán*, subtending the Highlands of *Cashmere*, where localities may be found for stations—fit for colonies—as guards to the *Indus* and *N.W. Doäbs* of the *Punjaub*, such as *Murrie*, and *Abbottabad*, &c.

Passing S.E. along the *Himalayan* subsidiary watershed, we find

the station of Dalhousie, dominating the Bári Doäb, and (though less effectively) the Rechna and Jullindar Doäbs. I should consider this an excellent locality for one of the Reserve Circles, Colonies, or Regiments we have been considering. I should incline to prefer it to Kangra, named by the reviewer already mentioned. At Kangra, I think a Volunteer Corps should have its head-quarters and consist of mounted infantry, *επακται*, or dragoons, as the old mounted foot-soldiers were called, *mounted rifles* of the present day. This lovely district is, as is well known, one of the chief centres of the tea-planting interest, and already a considerable European population reside there.

Going south, down the Himalayan watershed, we arrive at Simla—that imperial mountain already mentioned—where I have in my work placed what I designate the *Keyonthäl* Refuge, from the name of one of the small Hill States comprising its precincts.

Chákráta, a station in the fluvial basin of the Jumna.

Mussoorie with *Landaur*, dominating the Dehra Dun, which some authorities have at times sought to recommend as a capital for Hindostán, and a future seat of government. No doubt this sub-Alpine region dominates the Doäb and Oude as far even as Allahabad, and in that sense might be called the capital of *Hindostán* (which is a term only properly applied to that region of India alone). Sir George Campbell, in his work, "India as it may be," has, indeed, insisted on the peculiar eligibility of Mussoorie with Dehra Dun in this point of view, and without going quite so far as that able author, it may be safely conceded that there is much force in the suggestion.

The Kumäon Hills,—Almora, Raniket, Nainee Tal,—have been mentioned as dominating Rohilkund and N. Tirhoot. They are fully described in my work. But I must pass on southwards.

Here we find a fine hill country, "Nepaul," one of the best, indeed, in the whole range, unfortunately rendered unavailable to us from the fact of being out of our territory and independent; were it otherwise, probably the Valley of Khatmandoo would afford a fine site for settlement. It is also fully described in the work.

We now pass on to Darjeeling, and the region of British Sikkim, where no doubt splendid sites may be found for industrial development or colonies such as I have advocated. With this district, having been in command two years, I am well acquainted, and can affirm that no better locality can be found throughout India for one of the small experimental colonies, the elements of which I have sketched.

Passing across the Brahmapootra, we find the *Khassia* Hills, fully described in this work, chiefly from the works of Hooker and others. This is almost the only hill district in India not personally visited by me.

In the south of India, that noble plateau the Neilgherries seems in every way suitable for a large reserve circle or colony, and having had ample opportunities of observing it, I have entered rather minutely on its resources.

I would associate the Annamally and Pulnay Hills with this group.

Other blocks of mountain such as the Shervaroys and some small ranges rising above 4,000 feet, near the mouth of the Godavery, together with Coorg, Canara, the Wynaad, and the Mysore table-land, are treated of, but can only be just mentioned here.

Crossing the Toomboodra into the Dekhan we find ourselves in Mâhârâstrâ, the land of Sivaji, the Mahratta, the "Mountain Rat," as his proclivity for hill forts caused him to be called by his enemies the Moghuls. The Syhoodria Mountains or Western Ghauts are found to be the great buttress or mountain littoral of Western India, and contain a few sites for *sanitary* circles such as Mâhâbulêshwar, Mahteran, and the sites for camps echelloned along the summits of the Ghauts from Khandâla to Deolâlie. There are several summits, also, such as Mander Deo, Amber-Khind, Singhur, and others, rising to eminences above the zone of malaria, and presenting favourable *pieds de terre* for convalescent depôts and sanitarium; but most of the positions are cut off by torrent and flood in the excessive rainfall of the monsoon, and are of too restricted an area to enter into our consideration as sites for colonies, or even very large military circles.

I have entered very fully, however, on the *Hill Forts of the Dekhan* in my work, some of which are fine impregnable sites for refuges for a dominant race, numerically weak amidst rebellious populations.

Thence I have passed on into Central India, and from the plateau of Omer Kantak as centre, being the watershed or waterparting of the land (7,000), whence issue the great rivers Sône and Mahamuddy, which find their exit into the Bay of Bengal (the former through the Gangetic Valley), as also of the Nerbudda and Tapti, which, flowing westward, fall into the Indian Ocean north of Bombay, I have thence traced the courses of the various ranges such as the Vindhya, Keymore, Rajmahal, Mahadeo, and Pachmâri, &c., which ramify north-east, south, and west, and buttress in the table-land of Central India, forming steep escarpments in the courses of the rivers named. They afford but few sites for colonization of Europeans.

Thence I pass across the Nerbudda into *Upermal*, the *Highlands of Malwah* or *Rajpootâna*, till arriving at the *Aravelli* Mountains (the "*strong refuge*") I find the station of *Mt. Aboo* capable of holding a small reserve colony, valuable for its *strategic* position.

Various *pieds de terre* forming temporary refuges from the heat of the plains subtending them are sketched: such as a few of the *Droogs* of Southern India, *Mt. Parasnauth*, in *Raj Mahal*; the *Mâgâsani* and *Mylagiri* hills near *Balasore*, in *Cuttack*; and a few rock fortresses and elevated plateaux are cursorily alluded to, but they do not enter into our consideration as fit localities for *Colonies*.

I had ended my sketch of the *Highlands of India* with section 15—*Mt. Aboo* and the *Aravelli* spurs,—when the *Afghân* question arising, I made bold to add section 16, on the *Highlands of India Alba*, including the *Kurram* basin (of which I have some personal knowledge). The *Suleiman* Ranges, on which are found the small sanitariums of *Sheikh Boodeen*; *Fort Munro*; and *Dunna Towers* (South), as also *Peshin* and the basin of the *Lora*, which, with the *highlands* dominating them, I have termed *India Alba*, the ancient

Arachosia of geographers. In this I have been much indebted to the valuable papers of Sir M. Biddulph, who lectured in this theatre, of Sir R. Temple, who lectured at the Royal Geographical Society, of Mr. Clements Markham, C.B., the able Secretary R.G.S., whose valuable papers on Afghanistan are almost text books on the subject: and of Captain Holdich, also a lecturer in this Institution, a most able military surveyor, whose paper has also appeared in the Journal of the Institution.

We are now retreating from our objective, Kandahar, and the subject *Highlands of India Alba*, may, perhaps, possess but diminished interest: nevertheless, if we uphold the provisions of the Treaty of Gundamuk, much highland territory will fall within our frontier, and will have to be taken into consideration.

In former papers I have long been inclined to advocate frontier military villages, as a buffer or zone of defence against savage neighbours who, in their raids, would necessarily first fall foul of our warlike villagers and receive at their hands a "Borderer's Welcome!" And here I think I see an opening at various commanding points, to plant colonies of our loyal native subjects, who, in fact, form part of the scheme for the formation of a *reserve force for India* which it has been my object to suggest: but which from various causes I fear I have but feebly put before you, trusting more to the discussion which I hope may ensue, and elicit valuable opinions, rather than to my own crude and imperfect paper on the subject, which,—deprecating any dogmatic assertion of personal opinion—I offer simply as introductory and tentative.

The CHAIRMAN: I hope that some gentlemen present who have a knowledge of British India will supplement General Newall's Lecture, by giving us any information that they are able to afford us on this subject.

General Sir ORFEUR CAVENAGH, K.C.S.I.: I cannot but take great interest in the subject of the paper which has been read by our able lecturer, and if in any remarks I make upon it I may seem to throw some doubt upon the practicability of carrying out on a large scale the scheme which he has suggested, I hope that he will not think I am doing so in any cavilling spirit. On the contrary, my object is to elicit information from those who may be able to afford it better than myself in order that the question may be thoroughly thrashed out. There can be no doubt that the formation of military colonies would add materially to our political and military strength in India, but it seems to me that the great question to be considered is the employment of the colonists. I believe we should all agree upon one point, that you could not employ Europeans in the plains of India,—that they must be located in a temperate climate. With regard to the hills, I speak with very great hesitation, because although I have been through Nepal, and have been thirty years in India, I have never visited a hill-station, and therefore as to the capabilities of the several hill-stations, and the nature of the work that might be available for Europeans there, I am speaking without personal knowledge; but as far as I have been able to gather, all the opportunities that would be afforded for giving occupation to Europeans at these stations would be confined to the employment of a few artisans, such as tailors, shoemakers, and carpenters, and of a few persons who might be employed as overseers in the great tea and cinchona plantations. There would be in this way means for employing a certain number at every station, but how far that would be sufficient to enable you to maintain one or two regiments at any one locality may be a matter of some doubt. It seems to me that it would be difficult to give them out-door employment. The soil is generally so sterile that there would be no agricultural occupation; moreover, in all probability if you attempted to

employ European labour for agricultural purposes you would be undersold by native labour, which is so much cheaper that no person would employ Europeans when he could hire natives. I believe if it were possible for military colonies to be formed on a large scale, it might be done on one range to which General Newall has alluded, that is the Neilgherries. It might perhaps be feasible to establish there large cattle farms, both for sheep and oxen as well as horses, which could be managed by Europeans. It is an undulating country, and may in places be covered with fine grasses, and which might afford suitable localities for the establishment of military colonies. I am doubtful, however, whether similar facilities exist as regards the hill-stations along the Himalayas, except in a small degree—say for 100 or 200, at each station. I speak, however, with great diffidence, because I have never visited these stations myself, and I only judge the character of the mountain ranges from my visit to Nepal. Nepal might certainly be colonized, but that is a perfectly independent country. You have there a fine valley with a climate in which Europeans could work almost as well as they do in this country: but our own stations are bare ridges, where it would be almost impossible to find them occupation. At the same time I hold that the matter is of great importance, and it is quite possible that in some of the plateaux towards Central India—plateaux regarding which we have very little knowledge at the present moment—some small military colonies might be established as a commencement, and I therefore hope that the question will be taken into consideration by those whose duty it is to pre-arrange over the destinies of our great Empire in the East.

Mr. EDWIN CHADWICK, C.B.: I beg to remark on the alleged impossibility of the English soldier working in India. Very recently an Officer of Engineers told me that he had had his men out doing road work, in a blazing sun, and that they had done it well, and were in better condition than the men kept shut up in the barracks (where they had sunstrokes) doing nothing. The old India Company entertained the objection that the English could not live and work and have succession in India. The fact is, that they did not like them to settle there, where they would be inconvenient, and troublesome to their rule as unsystematized settlements may be. It has been alleged, however, that English children cannot be reared in India. In Calcutta we have the example of an orphan asylum for the children of English parents where the death-rate has been not more than seven in a thousand, that is to say, of about one-half the general death-rate of children of the same ages here in London. Now if those same orphan children, in Calcutta, were afterwards taken into the marshy plains where life amongst the natives is, indeed, short, their lives would be brief, and there would be little chance of succession; but if they were taken to hill-districts or plains in good sanitary condition, succession might be fairly relied upon. I had the honour to preside at a meeting at the Society of Arts, where we had a very able paper read by General McMurdo, urging the expediency of colonization in India, and the same general views that are set forth in General Newall's paper, but on wide and distinct observation. At that same meeting we had the representative of a fourth generation of English India planters, and there are others in various parts of India presenting examples of good succession. It was long put forth as an absolute dogma, that no English or whites, but only blacks, could live and work in the West Indies. In the course of my enquiries as a sanitary commissioner, I had an instance presented of a colony of German religionists, who had cleared and adapted the greater part of a parish, and were then living and working there, to a third generation, and are probably living there now. But there is evidence of longer white succession in India. Philologists and ethnologists show that the Afghans are actually our relations. In the course of his service General McMurdo occupied the district reached by Alexander the Great; and there he found, with Greek remains, people of a clearly Greek type, who had no doubt been left there. Instances are stated of small unsystematized attempts to get soldiers to settle that have failed; probably so; but of what soldiers and under what conditions? The axiom of Bonaparte, for war, that whilst physique is as one, morale is as two, must be kept in view in colonization, especially for India. I should not seek colonists from such a force as the home force, where there are six thousand desertions a year, from men who here cannot be trusted near drink, nor out of sight, nor out of a severely strained control; but they should be

sought from men of at least the morale of the Metropolitan Police Force; from men trusted and accustomed to individual action, or from the best non-commissioned officers; from select steady men, good shots, from such men as were to be found in the old Scotch regiments, the sons of farmers. Such men ought to be allowed to take such civil work as they could find for themselves in the first instance, and to be left to it, or to the formation of systematized settlements, in well selected sanitary sites, to be well kept under sanitary rule, with the condition of periodical musters and of joining colours under serious conditions. A well located and productive force will be in the main a self-supporting, and the cheapest and best of forces. Indeed, if we cannot settle in India we cannot be expected to hold India. It cannot be expected to be held under such insanitary administrations, and such insanitary commands, as those which incur far more loss of life from disease than from the sword. It may and must be held, if at all, by the application of the preventive science which saved an army and sent it home in better health than it had been in before, and that by its as yet partial applications has reduced by two-thirds the previous mortality of the army in India. Insanitary conditions will, in which men die in India, lose our dominion, but good sanitary conditions, in which men will live and settle, may extend and maintain it.

I would offer an explanation that, whilst there are malarial hot and dry conditions in the plains, there are cold and damp malarial conditions in the uplands of India. There, hill stations, that are passably good, selected as sanatoria, have from defective sanitary administration been made bad by the accumulations of filth or decaying vegetation about them or beneath them. It may be confidently averred that no failure of hill stations have occurred, without adequate, avoidable or removable causes. If enquiry be made at the department of the Indian Sanitary Commission, from Dr. Sutherland, I have no doubt of the cases of failure examined, a sufficient explanation may be obtained. I might have cited examples of what has been done by General Lord Mark Ker in the preservation of force by observation; and of sanitary knowledge in the preservation of force, by dealing with the conditions of sites.

Surgeon-General Dr. C. A. GORDON: Having recently come from India, I may be permitted to make a few remarks in regard to colonization in that country. We have an example of such colonization in the Portuguese. The Portuguese rule in India began and ended in the same century, and a writer on the subject attributes much of their downfall to the fact of their intermixture with the natives, and colonizing the country. From my own personal knowledge with reference to some places that have been mentioned, I know that in actual practice the results have not been satisfactory. During the time I was in Calcutta, when I had the honour of being a member of the Bengal Sanitary Commission, Parasnath Hill was utilized as a sanitarium, and with the result that the mortality amongst those sent up, calculated for the year, amounted to 99 per cent. I question very much whether colonization could be carried on on such terms. With regard to Raman Droog, near Bellary. I myself have had a good deal to do with that sanitarium for troops, Wellington being at so great a distance, that during the hot weather, when the soldiers required change, the railway journey was so long and fatiguing as to render their transit dangerous. But, in fact, during the rainy season and the latter part of the autumn, it proved so exceedingly unhealthy, that we had to withdraw the troops, and it is now, I believe, on my own recommendation, only utilized four months in the year, namely, in the cold and dry seasons. It has been found with regard to Droogs in India, and, in fact, with regard to precipitous hills arising suddenly from the plains elsewhere, that even at a height of 4,000, 5,000, or 6,000 feet, malarial diseases are more prevalent and fatal than in the plains. This is attributed to the fact that the malaria suddenly rises, and is wafted up through the ghauts, acquiring greater intensity than it has in the plains. With reference to the healthiness of hill stations, it has been pretty well proved by statistics and actual experience that soldiers who have suffered from organic disease in the hills, so far from recovering their health, deteriorate and die in greater proportion than they do in the plains. Young men sent up to the hills on their first arrival in India, no doubt do exceedingly well: but the fact has also transpired that those men, on being sent down to the plains to join their regiment, have to undergo a more

or less violent "seasoning," as it is called, with fever and other endemic diseases. We have two instances of the pernicious effects upon health exercised by residence on hill stations when necessity demands a sudden descent of the troops to the plains. One instance occurred at the time of the Mutiny, when what is now the 101st Regiment, the Bengal Fusiliers, was suddenly sent down from Kussowlie, and their sufferings from cholera were intense. A more recent instance occurs to my recollection with reference to the 58th. As the Officer who delivered this excellent lecture perfectly well remembers, Sinchal was occupied by a wing of the 58th, and it descended to Allahabad, where the corresponding wing immediately afterwards arrived from Benares. Cholera occurred at the station of Allahabad, but with reference to the 58th, it was almost entirely confined to the wing that had come from Sinchal. Of course the lesson to be learned from what I have mentioned is this: that residence in the hills renders the men who suddenly descend from the hills to the plains specially liable to any disease that may be epidemic at the time, more especially to cholera; and I believe it is a fact that many Officers and others who go to the hills periodically, as many do in India, run greater risk of becoming ill on descending to the plains than those do who continue in the plains. Then there is another point: many of those who have resided a considerable time in the plains, and are suddenly moved up to the hills, immediately become ill. There is another matter in which I believe statistics lead to erroneous conclusions, that is, with reference to the sanitary influence of the hill stations upon the troops. When the 42nd was sent there from Peshawur some time ago, suffering from cholera, no doubt they became healthy in the long run, but it was at the expense of the life of almost every man whose health had been impaired in the plains. In the 75th, also, a similar circumstance occurred. I had this from the late General Herbert, who commanded the 75th, and the honour of whose acquaintance I had. With regard to children, I can speak very distinctly on this subject, having had it brought before me when I was Principal Medical Officer in Madras. A number of children accompanying their fathers and mothers to the Neilgherries year after year died, and died in such great proportion, that the attention of the authorities was drawn to the subject. We naturally assumed that the cause of this was to be found at the headquarters of the regiment in not providing sufficient warm clothing to compensate for the sudden change of climate. Measures were taken to remedy this defect, warm clothing was provided, but the mortality still continued, and continued to a greater extent than it did amongst the children in the plains. Of course there are many other considerations connected with this interesting subject that I should be glad to allude to, and which I think demand a great deal of discussion, but these are points within my own knowledge, and I thought I might take the liberty of drawing attention to them.

MR. CHADWICK: I can only repeat my expression of confidence, that on examination adequate causes would be found at the outside, or in adjacent conditions, although inside the barracks all might be unexceptionally fair and good. I might have mentioned as respects the excessive mortality of children, held forth as inevitable, that whilst the mortality of adults was only 20 per 1,000, that of the children was upwards of 100 per 1,000; it appeared on examination, that whilst the sanitary condition of the men had been duly attended to, the children and the mothers had been so grossly neglected as fully to account for the difference.

A MEMBER: The existence and results of the Lawrence Asylum is a proof of what you have stated in regard to the effects of sanitary arrangements.

MR. CHADWICK: In respect to them generally, and to the due preservation of force, and the means of settlement, it is to be borne in mind, that for years a death-rate exceeding 60 per 1,000 was held forth confidently as the inevitable normal condition of our army; but that lately, and by the yet incomplete application of sanitary science, the army death-rates have been reduced to less than 20 per 1,000, and there is yet larger promise for civil settlement.

THE CHAIRMAN: I think we are wandering from the subject of the lecture, and entering upon a general discussion of sanitary questions connected with human life. I think we must now come back to General Newall's lecture.

Captain J. C. R. COLOMB: As I see no one else rising, rather than allow the discussion to terminate in observations as to matters of sanitary detail, I should wish to

make one or two very general remarks upon the Imperial importance of the question that the lecturer has raised. No doubt there must be a wide divergence of opinion in matters connected with sanitary science in all the great variety and complex mass of questions which a paper such as this involves. The desirability of increasing our military or our naval strength in outlying parts of our Empire is becoming a graver question every day. The safety of our sea communications with the outlying parts of the Empire cannot now be strictly calculated upon as absolutely secure, and that being so, as a matter of defensive policy, it is necessary, it appears to me, that the nation should wake up and look with more favourable eyes than hitherto it has done to the necessity of taking measures to decentralize, to a certain extent, its military strength by developing, in other parts of the Empire, reserve war power. That is a question of increasing importance. I do not wish to detain the meeting with such general remarks, but I think there is one passage in the lecturer's excellent paper that is very appropriate. "On the other hand, the Greek colonies (as also, indeed, the North American colonies of England, afterwards the United States of America), are standing examples of what colonies should *not* be, namely, settlements of disaffected citizens who afterwards became bitterly hostile, and even subversive to the parent State." That is unquestionably true; but I would remind the meeting that when you speak outside about military colonization, or anything of that sort, it is simply pooh-poohed. I would take this opportunity of reminding those present that within our own memory we have had the problem of military colonization dealt with at the expense of English taxpayers, for the purpose of planting military settlers in our colonies; but those settlers were foreigners. I allude to the settlement of the German Legion at the Cape. There are many persons who are of opinion that that was not a wise thing. I remember this fact, and I always make use of it when I am told that the idea of developing our military war power beyond our resources in other parts of the Empire is unpractical nonsense. It is an important thing to remember. I happened to be in Portsmouth at the time, and I remember that we had to disarm very many of the German Legion. I mounted guard over them myself many times. The question was, what was to be done with the Officers and men. When we had that question to deal with, we did not think military colonization nonsense. It is useful to remember that there was other precedent for military colonization established. I think when the full importance of the broad question of developing our naval or military strength in other parts of our Empire is brought forward in the form of a proposed system of naval or military colonization it is useful to remember we have a practical example that it has actually been done in our own times, not, unfortunately, for the benefit of British soldiers and seamen who have done their duty, but for the benefit of foreigners, many of whom had to be disarmed.

General NEWALL, in reply, said: It is now my duty to offer a few remarks in reply to the objections that have been raised,—first by Sir Orfeur Cavenagh, who tells us that he thinks there would hardly be spaces on which colonies could be planted; that the regions would be restricted, and the agricultural area small. I did not read the details of the table appended to the paper with reference to the waste lands of India. Some of them are clear, and others are ready for the axe; still there are vast areas for industrial avocations, not only agricultural, but pastoral and industrial. The same objection was raised to the suggestion at the meeting to which I have alluded as having been held at Darjeeling; General Maxwell raised some objections, and my own words in reply were: "The circles suggested might be composed of various artisans, besides shepherds, husbandmen, &c., whose crafts would supplement each other; and many sources of industrial labour would arise; even native labour might be availed of to supplement that of the skilled European artisan or agriculturist. Hitherto speculators had been content to scratch the earth and put in a little tea or potato seed here and there; but the resources of the Himalayas especially are enormous, and insufficiently developed. Metals, timber, a splendid flora containing valuable products; and water-power to any extent for sawmills," &c. The rearing of live-stock would form a considerable feature. Large profits are made by floating timber down the mountain rivers. There is water-power to any extent, and there are many other sources of industry. That was my remark also at the second lecture, which was delivered by

Captain Henderson on the actuarial aspect of the question. I instanced sites in the Darjeeling district which it had been my duty to inspect partly in a military capacity, and of course I had my eyes about me. There are magnificent plateaux there where cinchona, tea, and various other products are raised. Sheep farming is carried on, and wool has been sold for 8d. and 9d. per pound. Within my own knowledge, there is stock raised in the hills almost sufficient to supply the Commissariat. There is a splendid breed of hogs there that feed upon the acorns in the forest. Sheep are becoming very scarce in India—so scarce that the British troops are fed only one day in seven upon mutton. They have beef six days in the week, and I contend that that fact alone is sufficient to account for a great deal of the invaliding and death amongst the troops. Many gentlemen with whom I have consulted have said: "We cannot bear such strong meat as beef in a tropical climate like India, and the fact that men are obliged to have it six times in the week is something dreadful to think of." I have here a sketch of a little industrial farm that I had hoped might be countenanced had I continued at Darjeeling. Some experimental farms were established by the Commissariat at the instigation of Lord Strathnairn, but they would not pay, owing to circumstances which would be too long to enter upon. I put a series of questions as to why they proved a failure. We are in a dilemma in consequence of having a population of Europeans daily increasing, and interlopers in India, waifs and strays of society; were it not so, any other colony but that of India would be preferable for the location of British settlers. But we have to face different circumstances; we have to look at the political desirability of strengthening the hands of Government by a reserve; we have a dilemma to deal with on the spot, and we must avail ourselves of the floating population, which ought to be worked up into a "reserve." Sir Orfeur Cavenagh well observed that I did not defend a very large reserve. I was contented in the first instance with seconding the opinions of a reviewer in the *Calcutta Review*, who stated that 10,000 or, say, 13,000 all told, would be the number produced by his scheme. My own suggestion was that an experiment should be tried with 300 men, to see how it would answer. As far as I can see, they would maintain themselves as industrial producers, but they would have a small retaining fee, so to speak, to eke out their income. I think it is a *sine quâ non* that they should be married men. The wife would be literally the help-meet to these colonists. I think the difficulties will be overcome when we look at the unopened areas of country disclosed by Parliamentary reports amounting to millions of acres. Mr. Chadwick referred to the fact that the *morale* or the character of the British soldier was not favourable to settlement in the colonies. Now I have had some little experience as an Officer in India. We certainly received, in the first stage of our development, some very bad material to work up into good soldiers—the scourgings of Whitechapel and Westminster, in fact, men of the worst kind of morality that could possibly be, full of pot-house politics and sentiments radical in the extreme, distrusting their Officers and every one connected with them. During the time they were under my observation as soldiers, after they had met with fair and just treatment, and a patient hearing of their supposed wrongs, these reprobates developed into useful members of society. My own ideas are that every civilian would derive incalculable advantage by passing through the ranks of the army, by cultivation of habits of discipline, subordination to authority, respect for superiors, with religious sentiment as far as it can be induced, and the education which most of them receive in Army schools. I do not think there is anything in the natural character of Englishmen opposed to their being fit and proper colonists. I recommend especially that volunteering should be open to men of good character, and chiefly to married men. Surgeon-General Gordon brought forward instances of some isolated localities having been found unfit as sanitary *pieds de terre*. I did not claim anything for such spots, except as temporary refuges from the heat of the plains. They are sometimes twelve or thirteen degrees cooler than the plains at their feet. No doubt in

¹ I mention these facts because I think it probable that the suggested colonies (or circles) might supply the Commissariat with many desirable articles of food and material.

certain seasons malaria does ascend beyond the zone of 4,000 feet which I have drawn as a general line. With regard to Mount Párasnáth, which was abandoned because it was found injurious to the soldiers. A small colony of 30 or 40 was, I believe, kept there all the year round, during a season notoriously unhealthy, when this malaria does arise. As to some of the other places instanced, I only claim for them value as refuges against the heat of the plains, as summer residences during the sultry weather, nothing more. I do not include them in the areas for colonization such as I have suggested. With regard to the 58th Regiment at Sinchál, I am rather surprised at the objection taken by Dr. Gordon, because the statistics that have been brought before us by Dr. Ambrose, Assistant-Surgeon of that very regiment, pointed to an exactly different conclusion. He points out that during the time when the right wing was at Sinchál, a lofty hill-station over 8,000 feet elevation (too lofty probably, because diseases of a bronchial character occur there)—there were hardly any cases whatever of epidemic fever, and only 5 men died in three years out of an average strength of 435; he further says that in the left wing, which remained at Benares, seven times as many men died during the same period (1866-67-68), and Dr. Ambrose adds that there was nothing whatever but the difference of climate between the two stations to account for this amazing contrast. With regard to the mortality of children, it is a painful fact that, notwithstanding all our sanitation, the mortality of children in the plains of India remains the same; and it must be confessed that it is not appreciably affected by their removal to the hill climate, as one might suppose. That, however, is attributed by Dr. Ambrose and others whom I have consulted, and it agrees with my own observation, to deficient nourishment. The soldiers cannot afford to feed their children with the generous, liberal diet so essential to Europeans in India, and they perish from want of the proper necessities of life. I believe that is the conclusion to which Dr. Ambrose arrived. Captain Colomb has been kind enough to support the idea of colonization from an Imperial point of view, and his political reasoning commends itself to me. I am thankful to him for any support upon a question which doubtless presents great difficulties and requires to be thought out very carefully. At any time there might be a run upon the British garrisons, and it might be necessary to withdraw them. No doubt we have a fine native army to fall back upon, but we have had warnings, and we know there are subtle enemies at work. We know what happened in the case of a previous attempt to dispossess us of the soil of India. Intrigues of every kind shake the loyalty of our native population. In a time of profound peace, it is well to look to our resources, and I do believe that a reserve for India is one of those resources. It has been long overlooked, and I think the time has now arrived for its reconsideration.

The CHAIRMAN: This is not a subject on which I can claim to be in any way an authority, it would, therefore, be presumptuous in me to offer any remarks further than to request the audience to empower me to tender a vote of thanks to General Newall for his interesting lecture.

Friday, June 24, 1881.

COLONEL SIR LUMLEY GRAHAM, BART., Member of Council,
in the Chair.

ON THE TRAINING OF PRUSSIAN OFFICERS, THEIR
PROMOTION, AND HOW THEIR CAPABILITIES ARE
TESTED.

By Captain J. R. LUMLEY (late 13th Prussian Lancers).

I HOPE you will allow me to preface my remarks with the reason that has prompted me to bring the subject of my paper before you.

My family having been one of soldiers for generations, I naturally, from infancy, longed to become a soldier. A quibble of age, however, prevented my going to Sandhurst, and thus the hope of obtaining a commission without purchase was taken from me, and after passing a direct commission examination, when an appointment was offered me, I was unable, through family circumstances, to realize my desire and ambition. This led to my entering a foreign army, and since I have been debarred from giving the service of my sword to the country of my birth, still I cherish the hope that the experience I have gained may in some slight degree be of use to her, especially in these days when the proper reorganization and efficiency of the army should be the first thought of our statesmen and politicians.

Among the many vexed questions, paramount stands that of the promotion and training of our Officers, so, perhaps, the subject of my paper may be of some utility in this direction, if only to bring before the authorities who have the matter in hand a correct idea of the way in which it is carried out in Germany.

I will begin by pointing out how the German Army is officered. This is effected from two entirely different sources, viz., by the Cadets from the "Cadeten Corps," or military schools, and by the regimental "*Avantageurs*" accepted by the Colonels of regiments. *Competitive examinations do not exist, but, on the other hand, a high educational test is imposed on all those wishing to make the army their profession. This test would, in England, correspond to the matriculation at the London University.*

Of the Cadets coming from the Cadeten Corps, there are two classes, "Fähnrichs," and those who, after an extra year's training at the Military College, join their regiments as Officers. These latter are not popular with the Captains of the companies and squadrons to which they are attached, as for the first year or two they are next to useless, having had no practical experience, they are unable to impart instruction. The Fähnrich, who has the rank of a non-commissioned

officer, is required to go through all the practical work of a soldier, in fact, nearly the same as an "Avantageur," whose course of training I will now sketch.

"Avantageur" is the appellation given to any gentleman entering the Army with the object of becoming an Officer. *Many people in England are unaware that, in Germany, Officers never rise from the ranks, although nearly all have served in them, the principle adopted being that Officers and soldiers should belong to two totally distinct social classes, and that the infusion of the one into the other tends disadvantageously to both.* Having passed his test examination, the friends of the young gentleman wishing to become an "Avantageur," apply to the Colonel of the regiment he desires to enter to accept him as such. The Colonel has the power to act in this matter according to his own discretion; few, however, accept an "Avantageur" without previously consulting their Officers about him, but before doing so, cause the necessary inquiries to be made regarding his family connections, as well as pecuniary circumstances, for every "Avantageur" must have a certain yearly income to enable him to meet the requirements of his position. The necessary allowance varies in the cavalry from 10*l.* to 25*l.*, and in the infantry from 2*l.* to 10*l.* a month, according to the garrison of the regiment joined. "Avantageurs" are attached to specific squadrons, the Captains and Officers of which are entrusted with, and become responsible for their military training, they live in barracks, but have quarters to themselves, and are required to do all the military duties of the troopers, but are not subject to the menial work the latter have to perform. When on duty, there is no difference between their uniform and that of the troopers, but while off duty, permission is accorded them to wear one of finer material made at their own expense. As soon as the Lieutenant in whose section the "Avantageur" is reports that he can clean his accoutrements, saddle and groom his horse properly, the Captain orders him to do it in his presence, and if satisfied, tells the sergeant-major that he may be dispensed for the future from performing these duties; he is then allowed to pay a trooper to do them for him, but any negligence on the part of the soldier performing this work is no excuse for the "Avantageur," who is personally held responsible. On being dismissed his drill, he is made a corporal, and given a non-commissioned officer's section to superintend. Besides attending all the squadron drills he has to ride during the winter months in the Officers' classes. "Avantageurs," being gentlemen, are treated as such, they dine at mess with the Officers, and enjoy there the same privileges, although they must never forget that it is only on sufferance, and that until they become Officers, they are to keep their eyes and ears open, but mouths shut, and show the same respect and obedience to the Officers as when on duty. The younger Officers are exhorted to look after them, and to encourage their society in their rides and walks.

After five months' service, if recommended by the Captain, the "Avantageur" is made a non-commissioned officer, and does the duties of such, until he goes to the "Kriegs Schule," when he is usually promoted to be a "Fähnrich;" this occurs generally after he has served

about ten months. The "Kriegs Schule" course lasts also about ten months, at the end of which period he is required to pass a test examination in the following subjects:—Tactics, arms and ammunition of war, fortification, topography, and surveying, military regulations, military correspondence, and practical exercises, such as riding, fencing, gymnastics, and drill. Soon after his return to his regiment he becomes a "Degen-Fähnrich," which means an Ensign wearing an Officer's sword, he then ranks above the sergeant-major, and does Officer's duty until his Captain reports to the Colonel that he is fit to become an Officer. Now comes the "Offiziers Wahl," or election by the Officers, who having been assembled by the Colonel for this purpose, are told by him that the "Fähnrich" N.N. has obtained the necessary recommendations to become an Officer, and that he would propose to them to elect him a brother Officer, reminding them at the same time that if any one has an objection to make, that it is his duty to do so. The Officers then sign the election paper in the reverse order of seniority, a single dissenting voice preventing the candidate becoming an Officer, but such dissension must be founded on substantial reasons, such as that he has been guilty of dishonourable conduct, or is addicted to habits injurious to the position of an Officer. A Fähnrich, who has once been rejected, would seldom ever be elected by another regiment, so where such a thing might happen, and the offence has rather been one of want of tact than of a more serious nature, he is recommended to get transferred to some other regiment. From the foregoing, it will be understood that the position of an "Avantageur" is a most difficult one, requiring much tact and common sense to steer clear of the many shoals that lie in his way. Not only has he to master the details of his military duties, and show most rigid obedience to the Officers and non-commissioned officers, but he must also gain the affection of the former as well as the respect of the latter, so that when he is an Officer, his previous conduct shall have been *sans reproche*.

My service having been in the cavalry, I will, in speaking of the training of the Officers, confine my remarks to the Officers of that branch of the service. I shall thus be able to speak with more accuracy, and convey to your minds equally well the object I have in view. I will first of all call your attention to the fact, that in Germany the duties are carried on systematically throughout the whole army, repeating themselves at fixed periods every successive year, which is divided for working purposes into winter, summer, and manoeuvre periods, there being an interval of about six weeks between the former and latter, during which the horses are rested, and leave granted to the Officers and men. The squadron being the tactical unit, renders the position of Captains one of great responsibility and independence, as they are in every way directly responsible for the discipline and military efficiency of the men of their squadrons, as well as for the condition and proper breaking of their chargers. How this is carried out, as I will show later on, is practically left entirely in their hands.

The winter, or first period of the year, begins with the arrival of the

recruits in October, and continues till about Easter. The duties, which are confined to preliminary and setting-up drill, gymnastics, and theoretical instruction, are carried on independently in the separate squadrons by its Officers under the supervision and control of the Captain, who is responsible for all that is done, the Colonel interfering only in case he observes that the efficiency and uniformity of the regiment is threatened by the system adopted in his squadron by any particular Captain.

The "summer period" is especially devoted—in the mornings to squadron and regimental mounted drill, practical outpost and reconnaissance operations; in the afternoons to range-firing, gymnastics, and theoretical instruction.

The "manœuvre period" comprises detachment, brigade, divisional, and corps operations.

I will now describe the winter duties in a squadron of cavalry composed of 1 Captain, 1 First Lieutenant, 2 Second Lieutenants, 135 non-commissioned officers and men, and 145 horses. The composition of the different classes and their allotment to the Officers of the squadron lies entirely at the option of the Captain, who generally, however, distributes the duty somewhat after the following table:—

Morning.

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| 1 Hour.—Young remounts ridden by men in their third year who have shown aptitude for riding. | } Instruction given by the First Lieutenant daily, except Thursdays. |
| 1 Hour.—Old remounts ridden by non-commissioned officers, and men serving in their fourth year. | |
| 1 Hour.—II, Class A, men serving in their second year, and who have shown aptitude for riding on thoroughly broken charger, to bring them forward to ride young remounts the following year. | |
| 1 Hour.—II, Class B, backward and difficult horses ridden by non-commissioned officers and men of third year to improve the horses. | |
| 1 Hour.—I, Class A, average men of third and second years on like horses. | } Daily, except Thursday, by Junior Second Lieutenant. |
| 1 Hour.—I, Class B, the same as I, Class A. | |
| 1 Hour.—Foot drill of men not engaged otherwise. | |
| Five classes of recruits riding in the open for one and a-half hours. | } Daily by Senior Second Lieutenant, aided by five of the best non-commissioned officers. |
| One hour recruits' foot drill. | |
| One hour recruits' lance and sword drill. | |

Afternoon.

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|---|---------------------------------------|
| Theoretical instruction of non-commissioned officers and lance-corporals. | } One hour daily by First Lieutenant. |
|---|---------------------------------------|

Theoretical instruction of troopers.	}	Daily one hour each by Junior Second Lieutenants.
Gymnastics, and lance and sword exercise of troopers.		
Theoretical instruction of recruits.	}	One hour each by recruit Officer and non-commissioned officer.
Gymnastics.		

It will be seen from the foregoing tables that every Lieutenant has from five to six hours' personal instruction to give daily during the winter months, besides which he has to ride for two hours daily in the Officers' class, which is superintended by the Major. The Captain fixes the hours when the respective duties are to take place, and sends a report of the same to the regimental orderly room.

The Captain is considered to be on duty all day long, and is constantly present to see and hear if the instruction given by the Officers entrusted with the classes is in accordance with his ideas, but as a rule beyond, when handing over the classes to the respective Officers, laying down certain principles which he wishes them to carry out, he seldom interferes, unless some egregious incapability, or want of military principles, is displayed. Every now and then he will personally inspect the classes, and then make any remarks he may deem necessary, and request the Officer to pay attention to them in his future instructions.

At the close of the "winter period," separate inspections of the classes are held by the Colonel; on this occasion the Generals commanding the Army Corps, Divisions, and Brigades are present with their staffs, and pass criticism on each class, clearly giving their opinions on what was good and what was bad. By these means, not only the Officer in command of the class, but everybody else, is aware of the practical result of his winter's work, as well as of his efficiency as an Officer, as that is judged by what he has displayed through his men. Every squadron having similar classes, the Officers are urged on by a spirit of emulation to produce the best classes. Theoretical inspections are carried out in a like manner, the subject on which the men are to be examined *vivâ voce* being left to the option of the Inspecting Officer. During the winter months, every Lieutenant has to prepare an essay, or give a lecture on some given military subject.

The first part of the "summer period" is employed by the Captains in putting their squadrons together, and in drilling them as independent bodies. At the expiration of about six weeks, squadron inspections are held on the same principle as the winter inspections of the Lieutenants, and by the result of the same, the capabilities of the Captains are judged. The period between the squadron and regimental inspection is devoted to outpost and reconnaissance operations; during this time every Captain and Lieutenant has to carry out a practical operation of this kind, but to these I will refer in detail further on. Just before the manœuvres, a regimental inspection is held, and the efficiency of the Colonel undergoes a similar test to that already gone through by every officer in the regiment except the Major.

Having given a brief outline of the general training of the Officers,

I will, before pointing out how their capabilities are more minutely tested, place before you an idea of the system of promotion in the German Army.

The general principle by which promotion in the German Army is regulated is seniority, although both merit and inefficiency take very prominent parts in its working; of these two, however, the latter helps its rapidity to a far greater extent than the former, for while one man is promoted over the heads of others by merit, a hundred make room in the seniority list on account of inefficiency. Were selection by merit to form the sole means of promotion, it would be difficult to carry it out, and it must to some extent dwindle more or less into a system of patronage and favouritism; while, on the contrary, when such promotion is the exception, the qualifications of the Officer so promoted are of so exceptional a character, that his good fortune is rather looked upon with pleasure and pride by his comrades, than with a feeling of envy or jealousy.

It must not be supposed, however, that because the proportion of those leaving the Army on account of inefficiency is so great in comparison to those promoted by merit, that the former have not rendered valuable service to their country, but the acknowledged principle is that, although an Officer may be very efficient in the rank he holds, it does not follow he is capable of being equally so when promoted to a higher grade.

Promotion in the German Army may be described as being of three different kinds called "Front," "Adjutanten," and "General Stabs "Carrieren."

The "Front Carriere" is that known in England as regimental, the principal qualifications for which are being a good drill and instructor as well as a strict disciplinarian and brave leader. Such Officers seldom rise to higher commands than a brigade.

The "Adjutanten Carriere" has in England no applicable term, the duties performed by these officers in Germany being those done in England by personal Aides-de-camp and Brigade Majors, and to some extent by Assistant Adjutants and Quartermasters-General. The first step in the career begins by being Adjutant of a regiment, and I think the position would be best described as Military Secretary to the Colonel, Brigadier, Commanders of the Division or Army Corps to which they are attached.

These Officers sometimes enjoy a slight benefit in promotion, for on returning to regimental duty after a term of staff employ, they are either brought into a regiment, where, by the date of their commissions, they would be nearer promotion than in the one they belong to, or they get an antedated Commission in Army rank. I would here mention that in no circumstances is an Officer promoted in the German Army over the senior of his rank in his own regiment, nor even to a higher rank in another regiment, without previously antedating the Commission he holds, and transferring him with such to a senior command. To explain what I mean, should the Emperor desire to accelerate the promotion of the Second Captain of a regiment, he being junior in Army rank by a year to the Senior

Captain, he is transferred to another regiment as Senior Captain with an antedated Commission, so as to make him senior in Army rank to his former comrade, and thus allow his promotion to an earlier majority without casting a slur on the former. Should a Lieutenant be considered worthy of special promotion, in a like manner he is transferred with an antedated Commission to some other regiment. Promotion by merit does not exist in the German Army after an Officer has attained the rank of Major, all promotion after this is strictly seniority accelerated by the removal of those considered inefficient. The personal Aides-de-camp of Princes may also be considered among those belonging to the "Adjutanten Carriere;" these Officers are selected more for their social than military qualifications, they have seldom a brilliant military future before them, and are sooner or later selected to fill higher Court appointments.

The "General Stab," or staff career, paves the way to the highest commands in the Army, and gives to these Officers, by the time they become Majors, an advantage in promotion of about seven or eight years over all others. I will now explain how they are selected, and course of training they go through.

Staff Officers are taken from all branches of the service, but those presenting themselves for examination must be subalterns with three years' service at least. The examination to enter the "Kriegs "Akademie" is not competitive, but one rather for the purpose of testing the applicant's general intelligence, than his stored-up book-knowledge; whether the Officer is admitted or not, greatly depends upon the personal report sent in by his Colonel and his other superior Officers, whose remarks as to his general character, intelligence, and industry carry great weight. The consequence of this is that only ambitious, intelligent, and studious young Officers present themselves; ambitious, because they wish for quicker promotion; intelligent and studious, because they are aware that if they do not exhibit these qualities they are liable to be sent back to their regiments at any moment. One hundred Officers are chosen yearly to go to the Kriegs Akademie, and remain there as a rule three years, during which period they are sent for three months every year to do duty with some other branch of the service than their own; this takes place during the manœuvres. The course of study embraces all military subjects, history, geography, literature, mathematics, sciences, and the French, English, and Russian languages. At the end of the third year, Staff journeys are undertaken for the purpose of obtaining practical tests of the Officer's military capabilities. When the three years' course is over, all the Lieutenants return to their regiments, there being no special final examination or list of qualification. The Professors and the Director of the Academy name to Field-Marshal von Moltke those who have shown the highest general intelligence, and are the most industrious. Thirty of these are then chosen, attention being paid that they belong proportionately to the Infantry, Cavalry, and Artillery, to do duty with the Great General Staff in Berlin.

The time these Officers are so employed, one or two years, has a great bearing on their future career, for they are then, so to say, in a

superior school, the head of which is Field-Marshal von Moltke himself, who, while instructing them, learns to know and judge them.

After their service with the Great General Staff is finished, they all return to their respective regiments, but those specially recommended by Field-Marshal von Moltke are after a few months transferred to the Staff Corps, in which they soon become Captains. Officers in the Staff Corps generally return to do duty as Captains, Majors, and Colonels with the arm of the service to which they originally belonged, although in all these ranks they are recalled to the Staff Corps after one or two years' duty with their regiments. It is in their promotion from Lieutenant to Captain, and Captain to Major, that these Officers gain the advantage of seven or eight years over all other Officers of the Army.

It must not be imagined that the Staff Corps is solely open to the Officers whose training I have just described, as the authorities are liberal enough to acknowledge that among the remaining large number of Officers in the Army, there are some who for some reason were unable as Lieutenants to go to the *Kriegs Akademie*, but who would, however, make very superior Staff Officers. With this object in view, Colonels of regiments are requested to recommend to the Generals, and these to Field-Marshal von Moltke, any Officers who distinguished themselves by the knowledge of their profession, the extension of their ideas, and aptitude for military operations. Such recommendations have often to be minimized on account of the desire of Colonels to call for the recognition of the higher authorities for the services of good Officers. To Officers thus recommended Field-Marshal von Moltke sends subjects to be worked out, questions to be answered, and should he consider them capable of making good Staff Officers, he calls them to Berlin to do duty with the Great General Staff, and if they give proofs of real qualities, they are transferred to the Staff Corps and employed as Staff Officers.

I will now endeavour to show how the individual qualities of an Officer in each rank is tested, beginning with the junior Officers, which I have already partially done.

The Second Lieutenant's qualifications, besides being judged by the production of his winter classes, undergo, during the summer months, severe tests. The first is in the way of what is termed Officers' reconnaissance rides, and which I will best illustrate by giving the general orders issued regarding them:—

“The reconnaissance rides of Officers shall always be of an extended character, so that they may learn to get over long distances in a given time without unnecessarily tiring or distressing their horses. The time of departure is left to the discretion of the Officers, although three in the morning is recommended. The reconnaissance itself will not be confined to that of the road indicated, but also to a supposed position of an enemy on the same. Immediately on their return, Officers are to send in reports, accompanied by maps, drawn roughly to the scale of 1 to 25,000. The report should contain a description of the country, in which special attention is to be given to the facility of locomotion over the roads and country; commanding positions;

“parallel roads, by which great numbers of troops can be directed for concentration at one point; if a wood contains underwood or timber; in case of a river, its depth and breadth, rapidity of the water, places where it can be crossed, if its banks are accessible and exit practicable, and if the bed is firm; the places where railways would be most easily and effectively destroyed, for instance, at curves and junctions; villages, if the outskirts are enclosed or open, if and from what distance they are exposed to a line of fire, and number of men that could be quartered and provisioned in them. With regard to the supposed position of an enemy, the chief points calling for attention are; the front of the position, its length and extremities, if the position appears a defensive or offensive one, if capable of being turned from either side, and a description of the line of retreat. The patrols are to observe the enemy until ordered to return, a man being sent every two hours to the nearest telegraph station with a report as to all changes in the supposed enemy's position. No reconnaissance ride will be under 50 miles; the map need only show the ground occupied, and for two miles surrounding the supposed enemy's position.”

The manner in which an Officer carries out his reconnaissance ride is a criterion of his capabilities.

The second test is a practical field operation carried out against an opposing force, an instance of which I will now give, and describe how it is carried out and judged.

FIELD OPERATION FOR FIRST LIEUTENANT A.

General Idea.

A northern brigade has been beaten at Dorking by an enemy advancing from the south. The engagement lasted until dusk, and all connection between the opposing parties has been for the time lost.

Special Idea for Northern Brigade.

The Brigade has, during the night after the battle, marched to Leatherhead, intending to concentrate there and again oppose the advance of the enemy.

ORDERS FOR FIRST LIEUTENANT A.

The Officer in command of the rear guard of the Northern Brigade orders First Lieutenant A, with two troops of Dragoons, to take an outpost position north of the River Mole, occupy the bridges, and if attacked, endeavour to hold them; also to send out patrols to re-establish connection with the enemy.

FIELD OPERATION FOR FIRST LIEUTENANT B.

Special Idea for Southern Detachment.

The detachment obliged by darkness setting in, as well as through the fatigue of the troops, to desist from pursuit, bivouacked on the battle-field. As soon as the direction, supposed to be northward, in

superior school, the head of which is Field-Marshal von Moltke himself, who, while instructing them, learns to know and judge them.

After their service with the Great General Staff is finished, they all return to their respective regiments, but those specially recommended by Field-Marshal von Moltke are after a few months transferred to the Staff Corps, in which they soon become Captains. Officers in the Staff Corps generally return to do duty as Captains, Majors, and Colonels with the arm of the service to which they originally belonged, although in all these ranks they are recalled to the Staff Corps after one or two years' duty with their regiments. It is in their promotion from Lieutenant to Captain, and Captain to Major, that these Officers gain the advantage of seven or eight years over all other Officers of the Army.

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"parallel roads, by which great numbers of troops can be directed for concentration at one point; if a wood contains underwood or timber; in case of a river, its depth and breadth, rapidity of the water, places where it can be crossed, if its banks are accessible and exit practicable, and if the bed is firm; the places where railways would be most easily and effectively destroyed, for instance, at curves and junctions; villages, if the outskirts are enclosed or open, if and from what distance they are exposed to a line of fire, and number of men that could be quartered and provisioned in them. With regard to the supposed position of an enemy, the chief points calling for attention are; the front of the position, its length and extremities, if the position appears a defensive or offensive one, if capable of being turned from either side, and a description of the line of retreat. The patrols are to observe the enemy until ordered to return, a man being sent every two hours to the nearest telegraph station with a report as to all changes in the supposed enemy's position. No reconnaissance ride will be under 50 miles; the map need only show the ground occupied, and for two miles surrounding the supposed enemy's position."

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Special Idea for Southern Detachment.

The detachment obliged by darkness setting in, as well as through the fatigue of the troops, to desist from pursuit, bivouacked on the battle-field. As soon as the direction, supposed to be northward, in

which the enemy has retreated is positively known, the detachment will follow.

ORDERS FOR FIRST LIEUTENANT B.

First Lieutenant B is ordered by the Officer in command of the Southern Detachment to advance with $1\frac{1}{2}$ troops of Dragoons towards the River Mole, and report in what direction the enemy has retreated.

These operations are set for Lieutenants by the Major of the regiment, who names the hour for them to commence, and on the setting out of each party, the Commander is handed a letter containing the particulars I have just given. How the orders are carried out is entirely left with the Officers receiving them. The Officer who has set the work, with other superior Officers, ride about and observe the doings of each party, and when he thinks operations have reached a climax or advance far enough for the purpose of the general idea, he gives the order to stay them and assemble the Officers engaged.

Criticism of what has taken place is then held and is carried out in this manner.

The general and special ideas having been read, the opponents read out their orders and are asked, first the one, then the other, to state what dispositions they took to carry these out. They are then asked what reports were received, and to describe the general course the operations had taken and their endeavours to meet the different situations. After each Lieutenant has stated his case, the Major, Colonel, Brigadier, and other superior Officers, if present, pass their remarks upon what was done and very clearly demonstrate whether the way the operations have been conducted was in accordance with their views or not, and the Officers engaged are able to form a very concise opinion of the success they have had. Within 24 hours, reports, accompanied by a map, of the operations have to be sent in. In this manner are the military capacities of Lieutenants judged and tested, and it becomes very well known in every regiment what are the chances of every Officer for promotion long before the time arrives.

It will be seen from this account, that special set examinations for promotion in the German Army do not exist, but a thorough practical knowledge of his profession is rigidly enforced of every Officer.

The qualifications of Captains are judged by the general state of efficiency of their squadrons, by their ability in drilling their squadrons, and by the way they carry out their practical field operations, which are of a more extended character than those set to Lieutenants, and comprise the working of a mixed force, but are carried out and criticized in exactly the same manner. The qualifications of Majors are tested during the manœuvres, when they command for one day the advance guard and outposts of one of the operating Brigades. They also are subjected to the same criticism as the junior Officers, and have to send in a report of the operations they have conducted. The qualifications of Colonels are judged by the general state of their regiments, by the conduct and efficiency of

their Officers, and by the intelligence they display while commanding a brigade of mixed troops during the manœuvres. In like manner are the qualifications of Generals brought to the test.

I will now describe how the orders concerning the operations of a brigade are given and promulgated. Before the commencement of the manœuvre the General assembles all the Officers, reads them his orders, and acquaints them with the way he proposes to carry them out. He then disposes with his advance guard arrangements and gives to each Colonel his special instructions, who likewise inform their Officers of their intentions and allot to the Captains their specific duties; these in the same manner instruct their Lieutenants, and they, again, inform the men of the general object in view and give instruction to the non-commissioned officers regarding any special duty that may be required of them.

Besides these practical military tests, there are other things that influence the promotion of Officers, such as their personal character and physical abilities. The personal character of an Officer becomes known by the confidential reports written about him by his Colonel, but it would be a mistake to think that these reports have the object of enabling the latter to write confidentially anything injurious to an Officer when he would not tell him so plainly, for the very opposite is their recognized intention, they are to enable to bring forward the special good qualities of any particular Officer, and recommend him for employment in the manner for which he shows the most aptitude. When matters have reached such a pitch that a Colonel has to report unfavourably on the conduct of an Officer, the latter is on the verge of being removed from the service.

Now with regard to physical qualities and their influence on promotion. In Germany, age has nothing to do with retirement, while, on the contrary, infirmity of body has; experience shows that some men enjoy their full physical capacities at 60 years of age, while others are decrepit at 40 years, so where the physical requirements of an Officer are found wanting, he is removed from the service without regard to his age or military capabilities, while, on the other hand, as long as these are enjoyed by an Officer, he can remain in the service in spite of his age.

An Officer who has been out of active military employ for three or four years seldom or ever receives a military command again, for the general opinion is that military matters have so much advanced during that period, that his ideas would not meet the necessities of the situation, and that he would wish to go back to the customs in vogue when he was actively employed.

I would here explain that an Officer who would or may have been superseded seldom obliges the authorities to give him the hint to retire, for there exists a feeling of self-respect in this matter that compels the Officer so affected to leave the service of his own accord. By this system of promotion, it is found that Officers become Captains after 12 years', Majors after 18 to 20 years', Colonels after 25 years', Major-General after 32-35 years', and Lieutenant-General after 35 to 40 years' service. The great advantage enjoyed by the military autho-

rities in Germany, in judging the capabilities of their Officers, is that they are for lengthened periods continually under the eyes of their various Commanding Officers, and that each Officer is obliged to do, and is responsible for, the work entrusted to him.

I must add a few words regarding the feelings of Officers towards one another, and their mode of life in a regiment. There is a prevalent idea in England that the pecuniary position of Officers in Germany is superior to that enjoyed by their comrades in the English Army, but such is not the case: the great advantage enjoyed by German Officers is that their profession gives them a higher social position than they would otherwise be entitled to.

What I would specially bring to your notice is the "*entente cordiale*" that exists among Officers of every regiment, and the means employed by the Emperor of upholding and improving the feeling of comradeship among them. You never hear regimental matters spoken of nor discussed in the presence of strangers, and any Officer speaking disparagingly of another or of a lady would most certainly be at once called to account. If any one has a cause of complaint against another he has to lay it before the Council of Honour, which is formed for this purpose and is elected yearly by the Officers of each regiment.

This Council of Honour consists of three members, a Captain, First Lieutenant, and Second Lieutenant, who are elected in the following manner: Every Officer above the rank of First Lieutenant has a vote for all three members, First Lieutenants for both the 1st and 2nd Lieutenant representatives, Second Lieutenants only for the representatives of their rank. All disputes in any way affecting an Officer or complaint against the behaviour of any one of them is in the first instance brought before this Council, who either arrange the matter or decide what is to be done. Should, however, the charge be of so grave a nature that they consider it beyond their capacities, they report the case to the Colonel, who, after the usual formalities are complied with, orders the assembly of the Court of Honour to try it. The court of honour is composed of all the Officers of the regiment, the Colonel being president; the verdict is in accordance with the vote of the majority. An Officer can elect to be tried by the Court of Honour of another regiment should he prefer it.

It is considered of the greatest importance for the well-being of the Officers of a regiment that they should be brought together as much as possible, and with this idea the Emperor has been most liberal in providing very handsome messes for nearly the whole Army. In fact the feeling existing among Officers of a regiment in Germany is that of the members of a family.

With your permission, I will, before concluding this paper, quote the reason given by Colonel Stoffel, the French Military Attaché in Berlin before the War of 1870, for the superiority of the Prussian Army over all other European armies, which he attributes to two causes, the material and moral qualities of the nation. To the former qualities belong, he says, the superior organization of the Army, the higher degree of instruction of the Officers, non-commissioned

officers, and men, the prepared state for war by the actual possession of all necessary materials, arms, and equipment for its Army. To the moral qualities belong the superiority of education and the sense of duty. On the latter point I will quote him verbally:—

“Sense of duty is a quality that belongs particularly to the Prussian nation, and which contributes to increase the moral courage of its Army. It is developed all over the country and in all classes of society, so much so, that one cannot help being astonished when studying the Prussian nation. Not having at this moment to seek the causes of this feeling, I will content myself by bringing it to your notice. The most remarkable proof of this regard for sense of duty is furnished by all publicly employed members of the nation; receiving a surprising small amount of pay, often burdened with families, these men work all day with indefatigable zeal, without complaining or appearing to wish for less work or more ease, but solely urged on by what they consider to be their duty to their country.”

I have quoted this passage from Baron Stoffel's admirable reports on the Prussian Army, because I have learnt from experience that this sense of duty to their country, coupled with the honour, love, and respect that one and all bear to their Sovereign and leader, is the principal cause of their military superiority. If these feelings exist in Germany and produce such excellent results, I am certain that in our own country, where loyalty and devotion to the Sovereign are the paramount feelings of every British Officer, we may not unreasonably expect equally advantageous results.

The CHAIRMAN: I see an Officer present who will be able to tell us a great deal that is interesting on this subject, as he had peculiar powers of seeing what was going on in Germany. Having spent a long time there in a high official position, he must know more about the German Army than almost any one in this country.

Lieutenant-General SIR BEAUCHAMP WALKER, K.C.B.: I never refuse a challenge, much more from so good a friend as Sir Lumley Graham. I think we are very much indebted to Captain Lumley for the interesting exposition which he has given us on the mode of testing the qualifications of Officers in the Prussian Army. I could even wish that he had been a little more detailed; I wish he could have told us somewhat more of the infantry. I am afraid I cannot supplement the gap in that respect, because the details are not sufficiently at my fingers' ends to be able to give them to you without some previous consideration, and before coming here, I had hoped that he would advert generally to the mode in which the duties were carried on during the winter. It is through the instruction of the men by the Officers, and through the practical testing in the field of the Officers afterwards, that the Prussian Officer is relieved from the necessity of paper examinations, which I thoroughly detest, but I should like to know what we in the British Army are to do without them. The Prussian Army is a homogeneous whole. The infantry company is seldom or never detached from its regiment, the regiment is always in the same brigade, the brigade is always in the same division the division, is always in the same army corps; and therefore from the moment the Officer enters the Army, until he attains the highest command, he is under the eye and observation of the same person, of course with changes produced by Officers being promoted, and Officers retiring from the Service, but the Officer who has to report on his qualifications is always looking after him, has the opportunity of seeing what he is worth, and what he is doing. We have nothing of the kind. General Officers here have no more power of reporting on the actual qualification of the Officers than I have, and I can only report on the paper examinations that pass through my office. They see them for six months, at the

utmost for a year, and you hardly in that time become acquainted with the faces of the Officers. It is simply impossible that the General Officer can really conscientiously speak of the actual qualification and work of promotion of any Officer under him, except perhaps the Commanding Officer of a regiment, and that is hard work enough. Further than that, these admirable tests, by which our paper examinations are superseded, are impossible to be carried out here. I should like to know how many garrisons we have in England or Ireland, where there is any space on which you could send two Officers out to manœuvre against each other; the chances are that if you did so, you would be harassed to death, and prosecuted for trespass, and after having tried it once or twice, you would give it up, perfectly sickened with the attempt. You will observe in the details which Captain Lumley has given us, there is one really very onerous examination which is imposed upon English Officers from which Officers in the Prussian Army are almost entirely free, and that is the examination in Military Law. In Prussia really and truly the responsibility put upon Officers to a certain extent is not the same that is put upon us. In the first place, the Captain who has to perform the very onerous duty of supervision of which Captain Lumley has spoken, has little or no trouble with accounts. I perfectly remember the time when, having been a Captain for some years, I became a Major, and I was simply thankful I had no more to do with the company's accounts, one of the most troublesome and disagreeable duties an Officer has to carry out. From all duty of that nature the Captains in the Prussian Army are almost entirely relieved. Military law is not, I believe, a part of military education in Prussia, except in a very minor degree. It is only studied at the *Kriegs Schule*, under the head of instruction in military duties, and I do not think it is studied at the *Kriegs Akademie*.

Captain LUMLEY: It is included so far as regards the powers which the Captains have of punishing their men, and those powers are very limited.

Sir BEAUCHAMP WALKER: And every Court-martial in the Prussian Service is assisted by a Judge Advocate-General, and consequently all legal questions which arise are at once explained by this Officer.

Captain LUMLEY: These are members of the legal profession with military rank.

Sir BEAUCHAMP WALKER: Members of the legal profession, but who, like everybody else having served in the Army, does not come as a mere civilian lawyer to judge in military matters, but has to a certain extent acquired a knowledge of military technicalities. That is a very great relief. With us, the President of a Court-martial is a man who really ought to be a good lawyer. I know when I was working hard at my profession, one of the things to which I considerably devoted myself was military law, and I found very great advantage from it when I became a Field Officer, and sat as President of Courts-martial. I then found how necessary it was to have a thorough knowledge of military law, but still it is very hard work to study. It is the want of the chain of observation, and the want of the opportunity of testing a person's qualifications practically that forces us to this most disagreeable system in our Army of examinations on paper. I wish the time may come when we might see the English Army in brigades and divisions, and with larger opportunities for testing the Officers in the most important parts of actual military service,—in tactics, in reconnaissance, in field sketching and field fortification, but with the exception of Aldershot we have really nothing anywhere; look at Portsmouth, for instance; I should like to know what anybody could do at Portsmouth in the way of practically testing Officers; the only space you have is Southsea Common, and there, if you turned a sod, you would have the authorities down upon you immediately. We are therefore driven to the system of mere examinations on paper, for which, after three and a half years' experience in the office I now hold, I have the greatest dislike. One thing I particularly wish to say in this theatre, and I hope it will be carried abroad by any who may think my opinion worth mentioning: I must say the way in which the Officers of the Army, as far as I have seen, have met this very disagreeable necessity is worthy of the highest praise. There are, I should say, speaking broadly, about three classes of Officers. There is first a very small class who pass the whole of their time in trying to evade examinations in every way possible. I cannot say that they succeed very greatly in that respect, and I am very ably backed up by a gentleman

sitting behind me who takes uncommonly good care that as little chousing as possible takes place. These are men who think that the Army was made for them; they are often thoroughly good fellows, jolly companions, fond of sport. I do not mean to say that men who are fond of sport are generally belonging to that class,—far from it, but they are men who think the world is made for pleasure and for pleasure only, and repudiate the idea of being called upon to give a definite account of anything they ought to know. If any of you wished to go to a lawyer, would you go to a man who was notoriously a fool in his profession? Or if you were ill, would you go to an ignorant apothecary or to a mere quack, who knows nothing of medical science? No; you would go to a man who had thoroughly studied either profession,—who had made it the reason of his existence, and was thoroughly reliable. I do not know why any man in the British Army should think that a man can serve and command others, and rise in rank, unless he endeavours to make himself acquainted with the profession he has chosen, in the same way that other people do who have to work for their bread. Then come a considerably larger class of men who merely go through the examinations with no particular spirit—work through them, and are satisfied if they manage to scramble through. But there is a very large class now, and it is increasing very rapidly, who go in for honours at the examinations. One of the alterations that, with the sanction of His Royal Highness, I have been able to introduce is, that those who pass a specially good examination, are specially mentioned and noted as being Officers capable in that respect; and a very considerable number of men are most earnestly and eagerly working for the sake of gaining this special mention, which is to me an extremely gratifying consideration. I can only say, as a rule, the reports of the Garrison Instructors speak of the great diligence, attention, and desire for instruction shown by not a majority, but a very large majority—almost all the Officers who come to them. The only other remark I wish to make is with regard to what I said just now about the men who try to shirk examinations being probably men who think more of sport than anything else. One of the greatest mistakes ever made in this world is when people think that a love for sport, and for proper amusement, and particularly for athletic sports, is dissociated from those who come out most highly in intellectual qualifications. The best men that we have at the Staff College are always the best men all round; they are generally the best riders, the best cricketers, the best racket players. It is the same at Sandhurst and at Woolwich, and really there is no reason why a man should not study his profession thoroughly and carefully, and also have plenty of time for every possible sport, and excel in every sport also. Nobody in this world has been fonder of sport than I am; I have been a keen rider to hounds, a fisherman, an eager sportsman with the gun all my life; but I have always found time for work and study, and everybody can do the same. I therefore entirely repudiate the idea that the men who come out at the top, at the Staff College at Woolwich and at Sandhurst, are mere book-worms,—it is all nonsense. There are men who are mere students, but beyond that the very large proportion of men who come out best intellectually at all our examinations are men who are what I call good all round men,—as good sportsmen as they are students. I think Captain Lumley has given too small a number for the annual admissions to the Kriegs Akademie, which was very largely increased after the Army was Germanized, and I think now there are 300 pupils there, and 100 are admitted every year.

Captain LUMLEY: These figures are taken from Baron Stoffel's Reports.

Sir BEAUCHAMP WALKER: When I first went to Berlin there were only 200, and they have not been increased to 300.

Colonel BLUNDELL, Grenadier Guards: May I ask whether the junior Officers have personally to drill the squads?

Captain LUMLEY: Yes, they do; every command is given by the Officer personally on every occasion.

Colonel BLUNDELL: Is not the excessive cultivation of the junior Officer somewhat against the cultivation of the non-commissioned officer?

Captain LUMLEY: No; I think the non-commissioned officers must be instructors, because there are too many recruits for the Lieutenant in charge to instruct personally, and therefore he has the aid of five of the best non-commissioned officers in the regiment who have been prepared beforehand to instruct these

recruits. He himself instructs them occasionally altogether, but the recruits themselves, in small bodies of ten and twelve, are instructed by the non-commissioned officers in their riding drill and so on ; but all their foot drill, and all their lance and sword exercise drill, is carried out at the word of command of the Officer.

Colonel BLUNDELL : I ask the question because I have heard naval Officers contend that an error is made in their service in not utilizing their non-commissioned officers as is done in our military service. I must say, unless you give responsibility to non-commissioned officers in minor matters, you seem to lose one of the strongest elements of discipline. The Duke of Wellington said distinctly that our Army was a better disciplined Army than the Prussian Army in those days. Now, great changes have taken place since then, but I think that if the non-commissioned officer is practically eliminated there is a danger of losing discipline.

Captain LUMLEY : No ; quite the contrary. Non-commissioned officers have more influence over the men with the duties allotted to them, because they are the direct superintendents of the men ; they superintend the stable duties, and they are responsible to the Captain that the duties of their section are properly carried out, that the accoutrements are clean, and discipline is kept up in the rooms ; personally the non-commissioned officer in command of that especial section is responsible. There is one Officer per week on duty who does all the superintending work, and goes round occasionally when he pleases, but at no fixed period. All that is done by non-commissioned officers, but the instruction in drill is personally done by the Officer. It seems rather the other way about to the English system, because the non-commissioned officers instruct the men, while in Germany that is never done by the non-commissioned officers, except in the case of young recruits, who are instructed in their elementary duties by the non-commissioned officers : but the moment they come to a certain standard of efficiency, they are incorporated in bodies and entirely drilled by the Officer in charge.

General SIR WILLIAM CODRINGTON, G.C.B. : With the admiration that we must all feel for what may be termed the military pre-eminence of Germany, we must also remember that it is mainly a military Empire. On the contrary, we must look at England in a different light. We are a very constitutional country ; we do not admit our Officers to be independent of the civil law, that is one main difference, for I think I am right in saying that in Germany the Officers are not amenable, except to military law. See what a difference that makes with regard to the general feeling of a country in respect to the Army ; that is a system which you could not have in this country ; therefore we must remember that there is a very strong constitutional difference between the population of the two countries. Then, again, we must feel this—the Army of England is a subordinate service—first of all, it is subordinate to the general system of the country, and that naturally so ; but it is also subordinate to the Navy, even as an executive service ; and I have heard in this Institution the Secretary of State for War, Lord Herbert, mention this, and say that having been Secretary for the Admiralty as well as Secretary for War, he could always get 10,000*l.* for the Navy, when he could not get 1,000*l.* for the Army. That shows the very great difference with regard to the general feeling which England entertains for its Army and Navy. Then we must also consider, as a fair contrast to what is done in Germany with regard to its Officers, that the English Officer never forgets his civil status, or that he belongs to the civil life of his country. He is a country gentleman, he may be the son of the aristocracy, or the son of the gentry, or the son of the middle class of England, but he never forgets that he belongs to the citizen class of his country. In his usual habits of society, he does not keep aloof from others in the same way that I rather imagine takes place with the Officer class of Germany, which is a class apart from the civil life of the country,—that is to say, during the time he is an Officer. I think we must take these circumstances into consideration as a mark of difference necessary, perhaps, to the education of one, but not so necessary to the education of an English Officer. We trust very much to the independent school education of English gentlemen to make them fit for Officer life in England. That is scarcely the case, as I understand from the lecturer, in Germany. I will say, again, that the main point to consider in looking at the two nations is that we look upon ourselves as very much a part of the citizen life of England, we do not separate ourselves from the nation, whereas I rather imagine that in Germany the case

is different, perhaps necessarily so, they being a great military nation. That causes a different attention to details and to an education being given in Germany, which perhaps would not be so easily carried out in England. When we are on service, you will find no Officer in any country who will give greater attention to the efficiency of his men, and to the minutest detail in battle or in the trenches or necessary duties in the field, but it a little goes against the grain to do all the small work in peace which apparently is done in Germany. Whether it is politic or not in a great military nation to identify the Officer with these small details, I am not prepared to say; but I cannot but feel that in England to give to the Officer all the details of disagreeable fault finding, which necessarily must take place, might possibly somewhat interfere with the kindly feeling we wish to produce between the man and the Officer. I think there are various differences of that sort which, nationally and professionally, we must consider in making a comparison between our own and the German system.

Colonel MONCRIEFF, Scots Guards: It strikes me that the great difference between the German Army and ourselves is that the Germans have the good fortune (or not, as it may be), of getting their recruits once every year, in October; our recruits come in in handfuls all the year round. I think if all our recruits came at one time of year our military authorities would be very much inclined to put the superintendence of the men a great deal more under the Officers than they are able to do at present. For my part I should like to see the Officers have a great deal more to do with the entire superintendence of the men.

Lieutenant-Colonel Hon. PAUL METHUEN, Grenadier Guards: It is a very important matter in the German Army that each Officer is allowed, for the time being, entirely to manage the man himself, that is to say, from the time the recruit joins, the Lieutenant has the sole superintendence of him, after that he is given over to the Captain; the Captain after having him a certain time gives him over to the Commanding Officer of the battalion; the Commanding Officer drills him in the battalion; he is then drilled in the regiment by the Commanding Officer, then in the brigade by the Brigadier, after that he forms one in the division and is inspected by the Emperor. This inspection over, then comes the "Felddienst," in which the companies are left entirely to their own Captains; later on they are formed together into battalions and regiments; last of all come the manoeuvres. I think this regular chain of responsibility an admirable system. Here you have a machine which from the beginning is started and is worked right round to the end of the year. I do think what we most require in our Army, and I say it as an old Adjutant and therefore I am rather speaking against myself, is to take the power of the Adjutant away from him and give it to the Captains of companies, or, I would say, to the new Majors. I look upon the four Majors as the men who should have all power of discipline over their men the same as the Captain has over his men in Germany. There is no doubt whatever that the man that makes the German Army is the Captain of the company, and the sooner we look this fact in the face, the sooner we recognize that these four Majors are to make our battalion; the sooner the men, instead of looking to the Adjutant and Commanding Officer as the only two men of real authority, look to the four Majors as the four men they are to go to, the sooner we shall gain that knowledge of our duty which we see the Germans now possess. I am not a Staff College man, and therefore I can speak thoroughly frankly about another matter. I am sure there is no one here who has been in the Staff College who will not believe me when I say I do not desire to utter one word against Staff College Officers, but I do say most clearly that what is important in Germany is that out of the 100 men who go through the Staff College every year there are but 3½ per cent. who are appointed to the Staff, and these men are not appointed because they are the best at books only, but because they are the best all round, and I have not known in my experience in Germany one single Staff Officer who has been pointed out to me as a man in any way incapable for the high post which he is called upon to fulfil. They are loved and respected, not only by their brother Staff Officers, but also by all the regimental Officers, and this I consider is a point well worthy of consideration.

The CHAIRMAN: I should like to ask the lecturer two or three questions. First, with reference to the "Avantagours" who are attached to the squadrons; he states that

they live in barracks but have quarters to themselves, and while they are required to do all the military duties of the troopers they are not subject to the menial work the latter have to perform. Now, if I mistake not, it is the custom of these "Avantagés," when they first begin their service, not only to do the duties of the ranks, but also to live in the barrack-rooms.

Captain LUMLEY: That is not so.

The CHAIRMAN: I believe it is the case in the infantry. I suppose it is different in the cavalry. I should like to ask with regard to the very curious custom in the German Army, which I believe exists in no other Army, of the corps of Officers being able to put a veto on the appointment of an Officer. The lecturer has stated that a single dissenting voice will prevent the candidate becoming an Officer. I should like to ask whether he means that literally, or whether it is not the case that it is necessary for a majority to vote against the election of an Officer for that rejection to be final, and without any reason being stated; and if, on the other hand, a minority object to his appointment, if I understand right, the reason must then be given; but if the majority objects no reasons need be given. I would also ask whether such a representation has not to be made to the Emperor by the corps of Officers with regard to examinations for promotions. Captain Lumley has no doubt stated quite correctly what is the case with regard to promotion in the cavalry and infantry, but I should like to ask whether it is not the case that there is an examination for promotion on appointment to the rank of Captain, both in the Artillery and Engineers, what we call the Scientific Corps.

Captain LUMLEY, in reply, said: I must first of all thank everybody for the attention they paid while I read the paper, and also state that in reading it there was no intention on my part to draw a comparison in any way between the German and the English services. I especially avoided even alluding to anything that might appear like a comparison.

General Sir Beauchamp Walker, in referring to the Captains of squadrons and companies, spoke of the trouble taken in England with the company accounts. In Germany all the regimental accounts are made out by the regimental Paymaster. There is a Committee formed, of which the members are the regimental Paymaster, the Major, and the Colonel, and the Paymaster draws the money. The sergeant-major has only to send every ten days a report to the Colonel, stating how many men are individually employed, and how many have been in hospital, because they then draw less pay; and then the Paymaster hands over to the sergeant-major the amount necessary for the squadron or troop. The men are all assembled, and each man receives his pay. This is always done in the presence of one of the Lieutenants, who comes forward after the whole thing is over and challenges any man who has any additional claim to make. Unless a claim is then made it cannot afterwards be recognized. An entry is made in the book that all claims are satisfied. That is signed by the sergeant-major and Captain and then returned to the Paymaster. This proceeding simplifies the whole matter very much indeed, and puts an end to that great difficulty which General Walker alluded to.

Sir William Codrington spoke about the social status of the Officers in the German Army as compared with those in England. There is no doubt the point that he referred to is a great fact, namely, the Officers not being amenable to civil law, but that all their doings are tried by a military Court. I must tell you, however, that civil law in Germany is very much less severe than military law. Officers have to be a great deal more particular in their actions than civilians, on account of the Courts of Honour, which would never allow any undue advantage being granted them because they belong to a separated class. Sir William Codrington also referred to their social position with regard to civilians. The upper classes of Germany are the classes from which the Officers are taken; and, in fact, it is considered that the only professions which are gentlemanly and which a man, calling himself a gentleman, can adopt, are those paid by the State. There is a sort of idea that a merchant and a man who gives his time to trade is of a different class. But it is not so exclusive as has been made out, because the civilian who serves the Government in different civil capacities ranks on the same footing as the Officer. There is another class from which the Officers spring, namely, the landed gentry, which is the only other class considered gentlemanly. It is considered gentlemanly to farm your own

farm or to cultivate your own land, and all the landed proprietors in Germany are, in point of fact, gentlemen farmers, which is considered the proper thing. Therefore the class to which he refers is a very large one, as it comprises all the Officers of the Army, all the men in civil employ, and all the landed gentry of the country.

I quite agree with what Colonel Moncrieff said, that one of the great advantages in carrying out a system, such as I have described, in Germany is that they get their recruits at one time. The thing is carried on systematically year after year at the same periods, and that can only be done when you get your men at the same time, and it is considered very necessary that the Officers should instruct the men.

With regard to the position of the non-commissioned officer, whose first duty it is to preserve discipline amongst the men and teach them to behave themselves, to superintend them in their rooms, and attend to small details. These are the special duties of non-commissioned officers in Germany. They do not instruct, or only to a very small degree; they have to uphold discipline and to look after all inspection work. For my part, I should certainly prefer to instruct the men rather than go round and see every day that the rooms are clean or that the beef is properly weighed out. I think a non-commissioned officer, a good disciplinarian, one on whom you can rely, can do that much better than an Officer whose capabilities should be as a leader and instructor. The system has this great advantage, the soldier is taught that his Officer who instructs him knows exactly what is required, and what is right and what is wrong. I never saw in Germany what I saw in France during the war, there every prisoner that was taken put the blame on the incapacity of the Officers, who they accused of being either traitors or ignoramuses; you never would hear a Prussian say that. He could never say so, as the Officers teach the men everything personally; not only that, but are expected to know every man personally, where he comes from, who his father is, and if his father sends him little presents so as to enable him to have money and to enjoy life a little better than he otherwise would. It is necessary that the Officer should know these things, because there are many little duties bringing in small pecuniary remuneration which the Captain in command can give to a man whom he knows to be of a poor family, and to whom the additional pay will be an object. By these means the men learn to love their Officer, as he is always looking after their little wants. I always found that if you ask a man who he is and talk to him and interest yourself in him, he begins to think "My Officer is interested in me," and it is a great inducement for him to have more regard for you and to make a better soldier. In fact, I consider all this, instead of being disadvantageous, rather to be an improvement tending in the right direction.

With regard to the "Avantagours" living in barracks, they live in special rooms appointed for them. If there were several there would be two or three in one room, but they would never be put with the soldiers. I believe it is against all principle that the "Avantageur" and the soldier should be put together. It is the case in Austria, but I have never known it in Prussia.

There, with regard to their election, as I have said, one dissenting voice is sufficient to debar a man from becoming an Officer, but that must be accompanied by some real reason, and these reasons are more easily known to junior Officers than to the seniors, because the junior Officers are encouraged to have these young fellows who are in training with them. I have known a case where such a rejection did happen, and it happened on the information of one man. The charge was not denied, but, on the contrary, it was proved. It was the case of a young fellow who partook too freely of the bottle, and the moment he did so, he lost all respect towards the Officers with him, and, in fact, did not behave as a gentleman should. When he came forward for election, one of the Officers stated what had occurred at such and such a time, and that objection was enough. The young fellow was told that perhaps he might better his ways, and therefore, though they could not elect him there, he might be elected somewhere else. I do not think the proceedings, rejecting an Officer, are sent to the Emperor. Proceedings are only sent to the Emperor for confirmation when they have once been completed, and a Fähnrich, who would not become an Officer, would be got rid of in this way. First of all, where the majority of a regiment would be against the election, of course that would be perfectly well known to the Colonel beforehand, and he would never put the Officers in the position of having to reject

a man by bringing him forward. The man would simply be told that there was no chance of his becoming an Officer, and that it would be better that he should not insist. He can after a certain time demand an election, but he is privately informed that it would be better that he should not do so ; and if he insists upon staying they make use of a power which is in the hands of the Commander of the Division, to whom the matter is reported, and the young man is sent over to the reserve. They just tell him that he has served his year, he has paid expenses, and he goes to the reserve, and so the matter ends.

Colonel GREEN : Is there any notification of such a proceeding made to the general public ?

Captain LUMLEY : When a Fähnrich is sent to the reserve, a notice of it appears in the "Military Gazette."

The CHAIRMAN : Have you ever heard of any cases of this power of rejection being used improperly ?

Captain LUMLEY : No. Some regiments refuse to elect Jews as reserve Officers. There is a feeling against their election. With regard to examination for promotion, I believe every Artillery Officer has to go to the *Artillerie Schule*, and has to pass an examination before he becomes a Captain of the lowest class. I think I have answered all the questions that were put, and I only hope that no one will imagine that my object in lecturing here was in any way to try to introduce a system or to make a comparison. I came for the simple reason that perhaps the information I have gained might be of some value, and therefore wished to give you the benefit of my experience.

The CHAIRMAN : I think we must all see that Captain Lumley in his lecture did not say a word which led to any comparison between the English and Prussian Armies. Any suggestion of comparison between the two Armies was introduced, not by Captain Lumley, but by members who took part in this very interesting discussion. It only remains for me to convey the thanks of the audience to Captain Lumley for his very interesting lecture.

Friday, June 17, 1881.

GENERAL SIR J. LINTORN A. SIMMONS, G.C.B., R.E., &c., &c.,
in the Chair.

RANGE AND POSITION FINDING—PAST AND PRESENT.

By Captain H. WATKIN, R.A.

THE subject of the lecture I have been asked by the Council of this Institution to bring to your notice this afternoon, is that of "range and position finding;" one, the utility of which, up to the present time, has been little recognized in the Service.

The necessity of knowing the distance of the object to be fired at is not one that is forcibly brought to notice under the present system of training. All, or nearly all, firing takes place at measured ranges. The soldier on coming to the practice ground is told at what elevation to put his sight, and is satisfied when he makes a good score. How bitter must be his disappointment when he comes to actual warfare and finds that his fire, which was apparently so deadly at home, is harmless at the very time when it is a matter of life or death that it should be effective. Look, on the one hand, at the annual returns of the shooting of the Army, and on the other, at the actual results obtained in the last campaign in South Africa. What is the reason of this? Chiefly, I believe, because our soldiers are not taught (as they might be) to fire under conditions more nearly assimilating to those of actual service. For example, if dummies were put up as targets on broken ground, the men would soon find out how powerless they were to make effective practice, unless the distance were truly estimated, and would take a much keener interest in educating their eyes, even, perhaps, tolerating the use of an instrument that would help them out of their difficulty. Our artillery practice is, I consider, even more at fault, for though there may be some skill in holding a rifle straight when the range is known and the target stationary, there is absolutely none required to lay a gun under similar circumstances. The artillery also labour under the disadvantage of a very limited supply of ammunition; but I believe both these drawbacks to efficiency could be easily overcome without any increased expenditure. Anyone who has seriously tried to estimate distances, must have found how difficult it is to do so with even approximate accuracy on familiar ground and at short ranges. In a strange country, and at longer ranges, the unaided eye is so unreliable as to give results quite useless for any practical purpose. In the days of smooth-bores and Brown Besses, the correct estimation of the range was perhaps not a necessity, the difference between any two rounds fired under

similar conditions being considerable, but now that we have such guns as the 6- and 8-inch, which are capable of sending fifty out of a hundred shot into a vertical target 4×5 feet at a distance of a mile, surely it is worth while taking a little trouble to ascertain the distance, without which every round would be lost.

The following advantages would, I believe, be gained, if an efficient system of range-finding were introduced into the Army:—

1st. A demoralizing effect on the enemy by a fire efficient from its commencement.

2nd. A steadying effect on our own men.

3rd. A check on reckless expenditure of ammunition.

4th. A consequent saving in transport.

But, gentlemen, these advantages are not to be obtained by the course hitherto pursued; the distribution of a few range-finders to the Army without any organized staff, or system of training, is of no use whatever; it is courting failure and throwing discredit on the whole subject.

The opinion of Officers of high standing, and of great practical experience is, that the power of our artillery might be enormously increased by the habitual use of range-finders in the hands of properly trained men. Unless, then, some such system be organized, we shall soon be left hopelessly behind other nations who are devoting care and attention to the subject.

I might spend the whole time allotted to me this evening, in showing how our modern weapons of precision more than ever necessitate the adoption of instrumental means of getting the range. But interesting as is this part of the subject, the object of my lecture is not so much to discuss the necessity of range-finders, as to describe the various instruments that have been invented from time to time for this purpose.

There are two great divisions into which the subject may be divided, viz.:—

Range-Finders;
Position-Finders.

A *Range-Finder* may be defined as an instrument that only gives the distance from itself to the object sighted.

A *Position-Finder* is one that marks on a plan the exact position of the object, and thus gives the range to any and every point marked on that plan.



Thus, a range-finder at C would only give the distance AC; but a position-finder at C would mark the position of A with respect to

C, B, and D, and thus give the means of ascertaining the distances AC, AB, and AD.

Time will not allow of my even naming, much less describing, the various instruments that ingenious persons have from time to time invented, so I propose only to take a type of each class to illustrate the principles involved, as far as possible selecting those that have been most extensively experimented with or are in the Service. With regard to my own inventions, I shall only make mention of those that have been actually adopted into the Service.

RANGE-FINDERS.

It is exceedingly difficult to arrange these instruments into distinct classes so as to include all that have been invented; the table I have drawn up must not, therefore, be taken as complete, but it may serve to facilitate reference this evening.

There are, as you will observe, two large divisions into which range-finders may be divided:—

- A. Instruments available for infantry and field artillery service.
- B. Those for coast batteries.

Division A.

Range-finders under Division A must be still further subdivided into:—

- (a.) Instruments utilizing the velocity of sound in air.

Type.—Le Boulangé telemeter, stop-watches.

- (b.) Instruments working by means of the known length or height of a distant object.

Type.—(1.) Stadiometer.

(2.)—Elliott telescope.

- (c.) Instruments having a fixed short base.

Type.—Clerk, Guthrie, Adie, Berdan.

- (d.) Instruments measuring the distance by triangulation, the base being either of a fixed or variable length:—

(1.) Those partaking of the nature of a theodolite.

Type.—Nolan.

(2.) Those partaking of the nature of a sextant.

Type.—Gautier, Poste, Paschwitz, De Bylandt, Gouliez, Roberts, Weldon, Watkin, Edwards.

Division B.

The most important instruments that have been employed for coast batteries are those that utilize the height of the instrument above the water level as a base, the distance being ascertained from the angle of depression either by calculation, a slide rule, or automatically by the mechanical construction of the instrument.

Types.—Malta instrument, Bell's hydroscope, Italian sight, Watkin hydroclinometer and depression range-finder.

POSITION-FINDERS.

Of these instruments there are two classes :—

(a.) Those working with a fixed horizontal base, the angles at either end being measured.

Types.—Danish (Madsen's), Siemens, Watkin electric.

(b.) Those working by the height of the instrument above the water level.

Type.—Watkin depression position-finder.¹

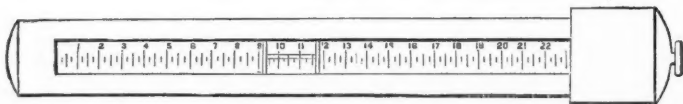
Description of Instruments illustrating the various Classes into which Range-Finders have been divided.

Division A.

(a.)—Instruments depending on the Velocity of Sound.

The Boulangé Telemeter.—Fig. 1 measures the interval of time between the flash and report of a gun. This interval multiplied by

FIG. 1.



the average rate at which sound travels gives the range. The instrument consists of a glass tube closed at both ends protected from injury by a brass case. Inside the glass tube, which is filled with liquid, is a *traveller* which falls slowly down the tube on the instrument being held in a vertical position. A scale calculated from the rate at which the traveller descends and the velocity of sound, gives the distance in metres. To use the instrument, bring the index to zero by inclining the head downwards. On observing the flash of the enemy's gun, bring the tube into a vertical position, thereby causing the traveller to descend. By tilting the instrument back into a horizontal position immediately the report is heard, the traveller is stopped and the range read off on the scale. It is evident that the practical utility of such an instrument is very limited, owing to the difficulty, when several guns are in action, of connecting the flash and report of any particular weapon; and there is the serious drawback of having to wait until the enemy commences firing. Moreover, the rate at which sound travels depends on the state of the atmosphere and the velocity and direction of the wind, and is therefore anything but a constant quantity.

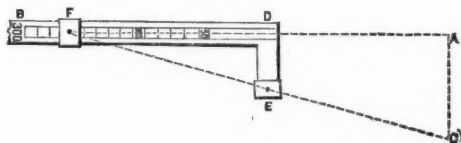
Several instruments partaking of the nature of stop-watches have been proposed for similarly obtaining the range; but besides being more expensive and complicated, are, perhaps, even less reliable than the one just described.

¹ As far as I am aware there is no other position-finder of this nature.

(b.)—*Instruments working from the Known Length or Height of a Distant Object.*

(1.) *Stadiometer.*—Fig 2. The simplest, perhaps, and best known of all range-finders, consists essentially of a graduated rod DB, along which slides a sight F. At right angles to DB are fixed two sights DE, at a distance, by the scale, of 40 yards.

FIG. 2.



To ascertain the distance of an object A, flags are set up at A and C, 40 yards apart; AC being at right angles to AB. BD having been directed on to A, the slide is moved back until the flag C is seen exactly on E. The reading of the scale at F gives the distance AF.

The principle on which the instrument is constructed is the familiar one of similar triangles. The triangles CAF being similar to the triangle EDF, and thus DF is the same multiple of DE that AF is of AC. DE being made on any scale to represent AC or 40 yards, FD on the same scale represents the distance AF. As ordinarily used, the instrument would be of no use in actual warfare, unless the enemy were obliging enough to fix flags at 40 yards apart; it can be used with a home base, but is then neither expeditious nor accurate.

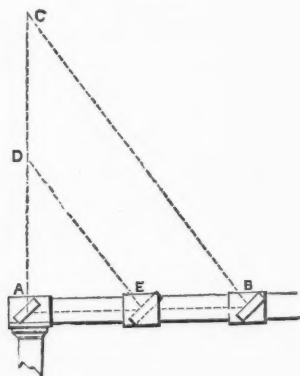
(2.) *Elliott's Telescope* measures the distance by the variable angle an object of known height subtends at different distances. This is accomplished by placing in the focus of the object-glass of a powerful telescope two horizontal wires, the distance between which can be varied by turning a ring. This ring is graduated in yards representing the distances at which a man of average height would be seen to occupy the space between the wires. Another scale gives the distances at which a mounted man would fill the same space. Several careful trials were made with this instrument by selecting men of the exact height for which the scale had been graduated, but the results were most unsatisfactory; they would have been still more unsatisfactory if the height of the men had been unknown. Another disadvantage under which instruments of this class labour is that they require very strong steady tripods fitted with rack-work for laying the cross-wires accurately, and wind or smoke would greatly add to the difficulty of manipulation. There are many other instruments very similar to the above, which only differ in the arrangement of the cross-wires, or the employment of a ruled glass diaphragm in lieu of them.

(c.) *Range-Finders having Fixed Short Bases.*

These instruments give the distance by the amount of parallax or

displacement of the object as seen from either end of the base. There are various methods in which the principle has been utilized, the oldest form being perhaps that brought forward by Colonel Clerk in 1870, but the principle of which was enunciated in the "Gentleman's Magazine" in the beginning of the present century. It consists of a half-silvered mirror, A, Fig. 3, fixed at an angle of 45° to one end

FIG. 3.



of a rod, AB; on this rod slides a frame, B, having a mirror at such an angle as to render the object C, as seen by direct vision and by double reflection from the mirrors A and B, exactly superimposed.

If, now, the frame B be drawn along the bar until the images of another object, D, are similarly coincident, it follows that $AC : AD :: AB : AE$, and thus the distance AD is known by simply measuring the distance AE. This arrangement, which appears simple and correct in principle, utterly breaks down in practice, owing to the great difficulty of superimposing the images with sufficient exactness, the displacement being so exceedingly small even when viewed with a powerful telescope. To illustrate this, let us suppose the distance of the object to be 1,000 yards and the length of the instrument 1 yard; it will be found that the angular displacement between this and another object 900 yards off is only $\cdot 38$ of a minute, or the angle subtended by $\frac{1}{50}$ of an inch at the end of a room 50 feet long.

Guthrie's Range-Finder, Fig. 4, shown in the plate, has a somewhat similar arrangement of mirrors E, F, and telescope C; but the distance is measured by the angular displacement of the mirror E, actuated through a system of levers, AB, CD, by the screw H. Fixed to the end of this screw is a disc, K, having engraved on its surface a continuous spiral, in which runs a pointer, L, indicating the range. The same observations as regards the accuracy to be expected from such an arrangement apply to this as well as to Clerk's instrument, and the results obtained were highly unsatisfactory. Adie's is another

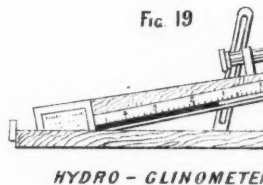
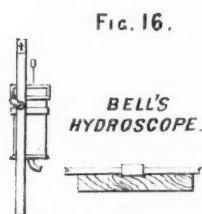
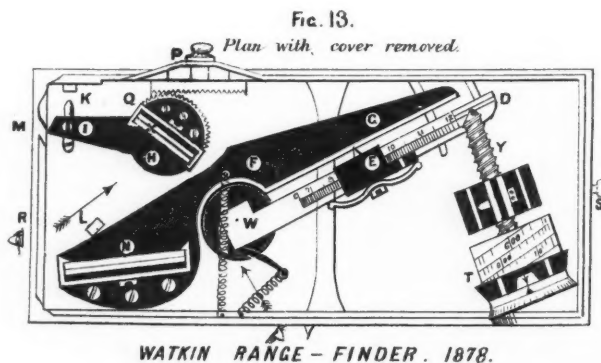
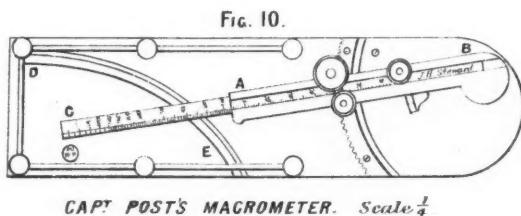
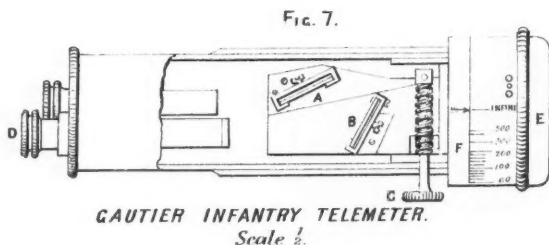
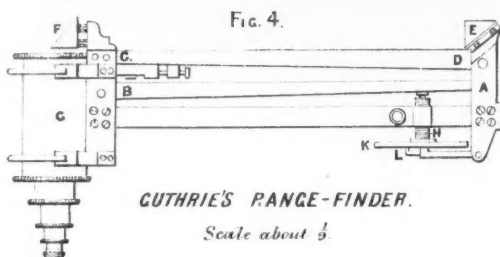
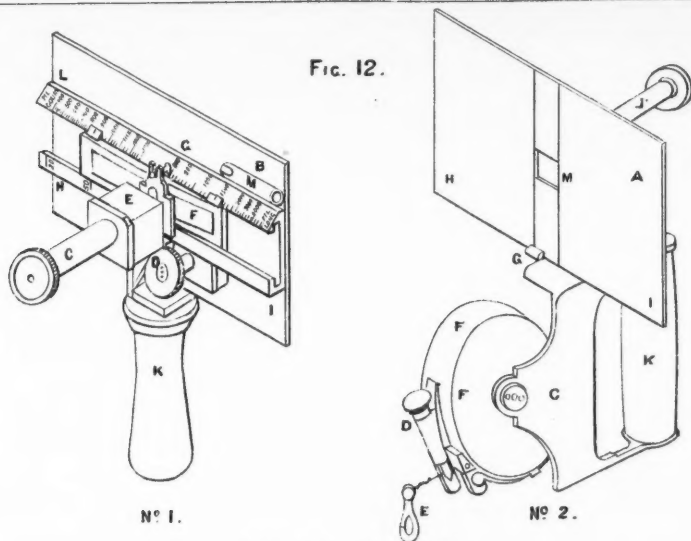
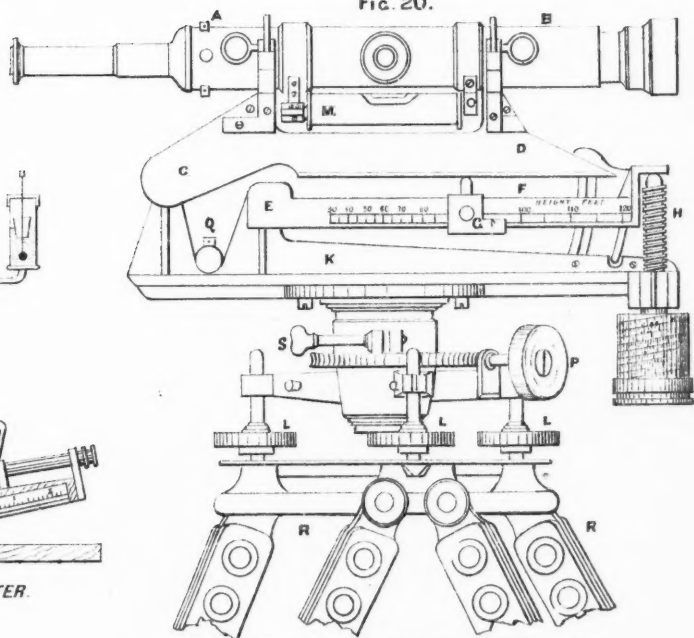


FIG. 12.



GOULIER TELEMETER.

FIG. 20.



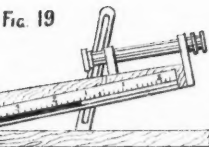
WATKIN DEPRESSION RANGE FINDER. 1880.

FIG. 16.

BELL'S
PROSCOPE.



FIG. 19



CLINOMETER.

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form of short-base instrument, somewhat similar in principle, a description of which will be found in the *Journal of this Institution*, vol. xxiv, No. CV, page 230 *et seq.*

The most elaborate instrument of this class, however, is the *Berdan Range-Finder*; but, unfortunately, the expense of the instrument (1,000*l.*), and the onerous conditions under which alone the inventor will supply it, has precluded any trials in this country. Several sizes have been designed for field and coast batteries. The field instrument consists of two very large telescopes fixed at a distance apart of six feet, the one being capable of slight angular displacement. To obtain the range the cross-wires of both telescopes are directed on to exactly the same portion of the object, the angular movement of the movable telescope, as registered by a micrometer screw, gives the distance. The instrument is transported on a spring cart.

The coast battery instrument is of similar design, but works with a longer base.

(d.) *Range-Finders measuring the Distance by Triangulation.*

(1.) *Instruments of the Theodolite Type.*

The most notable range-finder of this nature is that invented by Major Nolan, R.A., and which was, until recently, the Service instrument for field and horse artillery, and is still in use in the siege train.

The range-finder consists of—

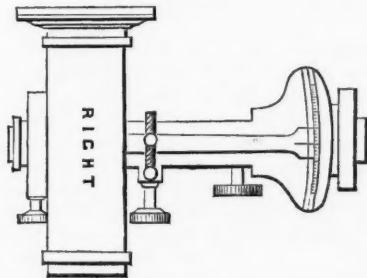
- Two instruments.
- A calculating disc.
- A tape.

Each instrument has the following principal parts, viz. :—

- The main telescope.
- The cross telescope.
- Plate with divided arc.
- Arm and vernier.
- Cylinder and face.

The main telescope has its axis marked by cross-wires, and is fitted

FIG. 5.



with a focussing screw. It rests in two V's, one at each end of a bar fitting into the head of a tripod. A traversing screw is fitted to the rear V for facilitating final adjustment. Over the main telescope is placed an arm working on a pivot near the eye-glass end. Over this pivot, and at right angles to the arm, is the cross telescope; at the other extremity is a vernier, which subdivides a graduated arc fixed near the object-glass of the main telescope.

The cross telescope has its axis marked by cross-wires, and is protected from injury by a cylindrical case fixed to the main telescope, on one end of which is a white face with two marks showing its vertical axis. Vertical motion can be given to both telescopes by suitable rack-work and screw. When the instruments are at A and B, Fig. 6,

FIG. 6.



the lines of sight of the main telescopes are in the direction AC and BC. As the cross telescopes are at the same time laid on A and B respectively, the reading of the arc gives the base angles, CAB and CBA. Major Nolan adopts a peculiar notation for his arc and vernier, labelling every $2\frac{1}{2}^\circ$ as 0, and subdividing each of these by the aid of the vernier into 100 parts. The calculating disc has seven scales marked upon it, and is used for mechanically calculating the range without the aid of logarithms.

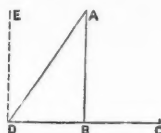
(2.) *Range-Finders of the Sextant Type.*

A large number of instruments of this nature have been designed, all possessing some slight peculiarity. I shall, however, only be able to select a few.

The Gautier Telemeter (see Plate XXI, Fig. 7), used I believe by the French, is a nicely finished, portable instrument, fairly accurate at short ranges. Two mirrors, A, B, are placed in the body of the instrument, inclined at 45° to one another, one of which, A, is capable of slight movement by means of the projecting screw C.

A small Galilean telescope D enables the observer to view an object directly in line with the axis of the instrument, and at the same time another at right angles to it by double reflection in the mirrors. The rotation of a prism placed beyond the mirrors slightly displaces the direction in which the object is viewed. The amount of displacement due to this rotation is conveniently marked on a scale F, showing multiples of the base employed. To obtain the range of an object A, Fig. 8, the observer at B selects some conspicuous object C, so that ABC is nearly a right angle. The image of C, as seen by reflection, will then be nearly over A, seen by direct vision. Exact coincidence is obtained by moving the projecting screw. The observer now moves to D, when he will find that the reflection of C is no longer

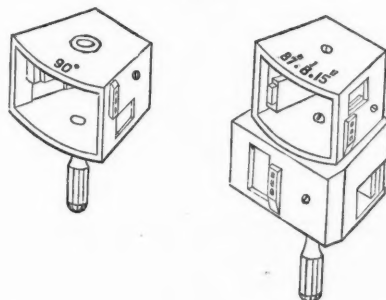
FIG. 8.



over A, but at some distance to the left of it. Exact coincidence is now obtained by revolving the prism, and the scale is read off. The base DB multiplied by this number will give the distance AB.

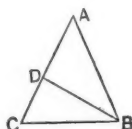
Many range-finders have been designed which work with fixed angles, the distance being a multiple of the base employed. Colonel Drayson many years ago utilized the pocket sextant for this purpose by clamping the index glass at various angles, representing different multiples of the base. Mr. Erskine Scott has also adopted a somewhat similar arrangement. De Bylandt, see Fig. 9, about eight years ago brought out a range-finder on this principle, which has had many imitators. This consists of a hollow casting of brass, to the sides of which are fixed mirrors. One instrument has the mirrors so arranged as to reflect angles of 90° , the other angles of $87^\circ 8' 15''$. To use the range-finder two observers are required. The one at B, Fig. 8, with the 90° instrument, places himself so as to see D reflected exactly over A; the other at D with the other instrument, so that B is coincided with A. The distance separating B and D multiplied by 20 will give the range AB. A second instrument with the mirrors arranged to read angles of $5^\circ 42' 30''$ was also employed in order to measure the base BD by means of a sub-base one-tenth its length. The sub-base was then exactly one two-hundredth of the range.

FIG. 9.



Major Weldon has invented an instrument almost identical with this, with the exception that he uses the same angle at either end, viz., $88^\circ 34'$; the range being thus also twenty times the base. He also employs a double reflecting prism for the same purpose.

Lieutenant Edwards, R.A., has recently devised a method of range-finding, in which he uses a prism reflecting the same angle as that employed by Major Weldon. To take the range AB, three observers

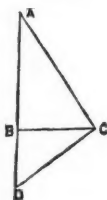


with three instruments arrange themselves at B, D, and C, so that the angles ABC, BDC, and DCB are all $88^{\circ} 34'$. CB is therefore one-twentieth of AB, and CD one-twentieth of CB, or CD is one four-hundredth of the range. A tape, specially prepared on this principle, gives the range direct from the measurement of CD.

Captain Post's macrometer, see Plate, Fig. 10, is a most ingenious instrument in which a slide-rule BAC is fitted to a sextant, doing away with the necessity of any calculation. This scale moves over a raised piece of metal, on which is engraved a curved line DE. Two observers A and B are necessary to take the range. A places himself, by the aid of an optical square, in the right angle between the object and B. B makes the reflection of A and the object coincident by moving the index glass with its attached arm, and clamps it in this position. A then paces or measures his distance from B, who slides out his scale of bases to that amount, and reads off the range where the curved line cuts the scale.

The Paschwitz Range-Finder, Fig. 11, works on the following principle. A right angle is, as usual, set up at B between the object

FIG. 11.



A and the observer at C. If ACD be now made a right angle, BD will be a measure of the range AB, for the triangles ABC, CBD are similar to one another.

$$\therefore \frac{AB}{BC} = \frac{BC}{BD},$$

$$\therefore AB = \frac{BC^2}{BD}.$$

Paschwitz employs a telescope fitted with an optical square for obtaining the right angles, the same instrument being used at B and C. A graduated board is placed at BD, and the number that is seen in the telescope at C to be in coincidence with the object A indicates the range AB.

Captain Roberts has also lately invented a range-finder based on this principle.

The instrument requires one observer, with an assistant, to work it, and consists of—

1. A telescope on a tripod.
2. A graduated rod about 6 feet long.
3. A simple calculator.

1. In the focus of the telescope are placed two parallel lines (either cut on glass or made of the ordinary spider's web), which subtend a fixed angle ($\tan^{-1} \frac{1}{10}$). The sunshade of the telescope carries a double reflecting prism (angle reflected = 90°), which can be moved at pleasure opposite to, or away from, the object-glass.

The tripod is fitted with a head which gives elevating and traversing motion.

2. A light rod, about $1\frac{1}{2}$ in. \times 1 in. in cross section, has a scale marked on one side. Parallel to, and slightly above, its top edge is fixed a small telescope with a prism reflecting objects at a right angle. If desirable this rod can be made to fold into a length of 3 feet 6 inches.

3. A slide rule, about 10 inches in length, with two scales marked on it.

To use the instrument, the tripod is planted in any convenient position. The telescope is focussed (its eye-piece turned so as to bring the two wires nearly vertical) and laid so that the centre of the left-hand wire cuts the object whose range is required. The observer then turns the prism so as to bring it opposite to the object-glass, and, taking the graduated rod, walks to the left a distance of from 20 to 80 yards; then, throwing the rod over his right shoulder, he looks through the rod-telescope, and so places himself as to reflect a fixed mark on the exterior of the tripod-telescope on to the distant object. When exactly in position he calls "ready," on which the assistant, who is now looking through the tripod-telescope, reads the number opposite the left-hand wire; should the rod not appear in the centre of the field, he turns the sunshade till it does so.

Without removing his eye from the tripod-telescope, the assistant next traverses the telescope so as to make the right-hand wire cut an index on the rod, and reads a second number on the latter by the left-hand wire. The coincidence of these two readings on the calculator gives the range.

The Goulier Telemeter, Fig. 12 (Plate XXI), is an ingenious adaptation of the familiar fact that a ray of light passing through a prism is reflected according to the angle which the faces make with one another. The instrument consists of two parts, which are identical as regards the optical means of obtaining a right range, so that two observers at D and B, Fig. 8, would be able to lay off the right angles EDB, ABD. The

instrument at D is fitted with a curved glass prism, F, Fig. 12, which being moved across the field of view bends the ray away from the right angle. The amount of movement to bring B coincident with A is a measure of the angle EDA. As the base is a fixed one, a wire being stretched from the reel on the instrument at B to D, the scale showing the position of the prism gives the range in metres.

The Watkin Range-Finder.—The last field range-finder which I shall describe is one of my own invention, and at present the Service instrument for Horse and Field Artillery and Infantry. The infantry instrument is now identical in construction with the artillery pattern, only differing from it in size and weight.

The range-finder is double reflecting, on the principle of the ordinary sextant, but is so constructed that the near object is seen by reflection, and the distant one by direct vision, thus rendering it easier and quicker to use, more particularly in hazy weather.

The instrument consists of a brass rectangular box, carried, when not in use, in a leather case slung over the shoulder like an ordinary field-glass. When in use half of the cover is thrown back, thus exposing the right half of the instrument. In Fig. 13 the instrument is shown with the whole cover removed. In the cover is carried a key for adjusting, and a small telescope for use in taking long ranges. There are two eye-holes, V and R, Fig. 13, fitted with movable slides so that the instrument can be used with or without the telescope; the arrows indicate the direction in which the observation is taken.

On a bell metal arm, FG, pivoting at N, is fixed a mirror, N, similar to the index-glass of an ordinary sextant. Another glass, X, corresponding with the horizon-glass of a sextant, is secured to a shorter metal arm, HI, capable of revolving round a pivot at H, and fitted at I with a steel screw. This arm plays between two steel blocks, K and L, so placed as to allow of a traverse of 45° , and is moved by the rack Q, actuated by the knob P.

By this arrangement the position of the screw I can be altered relatively to the arm HI, without disturbing the total angular traverse of the mirror X, which remains constant at 45° . If then the arm HI be locked in position, so that the screw I bears against the block L, by screwing or unscrewing I, the mirror X can be adjusted parallel to the index-glass N. An optically true right angle will then be secured by traversing the arm until the screw I presses against the block K. By this arrangement the instrument can be tested, and by using the key carried in the cover, adjusted in a few moments.

Pressing against the edge FG is a steel projection on the sliding collar E. This collar slides on a brass arm, WD, pivoted at W, and graduated with a scale of yards representing the different lengths of base with which the instrument can be used.

At the extremity of WD is a steel block D, against which the screw Y bears. This screw is rigidly fixed to a metal cylinder T, on which is engraved a scale of ranges. When the screw Y is turned the arm WD is moved on its pivot W, and the sliding collar E, bearing against the arm FG, causes it to move on its pivot at N, and thus alters the angle of inclination of the mirror N. The amount of motion

of the screw Y to give a definite movement to the mirror N depends on the position of the sliding collar E on the arm WD; consequently, by setting this collar to the proper graduation for the base used, the one scale of yards engraved on the cylinder T will give the range within the limits of the graduations, without any calculation whatever.

The principle of this will be better understood by reference to the following figure (14). Suppose O an object, distant 1,000 yards, AC a base of 120 yards, and DC a base of 60 yards. The angle AOC will be practically double the angle DOC, and generally, if $AC = nDC$, the angle $AOC = n$ times the angle DOC .

FIG. 14.



As there is only one given position of the cylinder and screw for any given range, some arrangement had to be devised by which the inclination of the mirrors might be altered, irrespective of the screw, so to cause them to assume a greater inclination for a large base than for a small one.

This is arrived at by means of the arm WD, Fig. 13, with the sliding collar E bearing against the arm FG. As these two arms pivot at N and W, it is evident that the further the slide is away from W, the greater will be the movement of the arm FG (and consequently of the mirror fixed to it), for any definite movement of the screw Y.

The following is the method of using the instrument:—Suppose the distance C to O to be required, pickets A and B are planted at a dis-

FIG. 15.



tance of six yards from one another. The observer plants a picket, C, about 100 yards off (by the aid of the instrument) in the right angle between O and A; then facing A he obtains the length of the base by unscrewing the drum and reflecting B on to A. Setting the sliding-collar to this distance he proceeds to A, and by again moving the drum causes the reflection of C to coincide with O, and reads the range.

The chief peculiarities to which I would draw your attention are—

1st. The means of obtaining a true right angle.

2nd. The measurement of the base by the same appliances as those used for the range.

3rd. The mechanical means employed for obtaining the range, with any base, and without calculation.

With good observers the instrument is capable of taking a range to within $\frac{1}{2}$ per cent. I might show you the result of several official trials, but it will, perhaps, be sufficient to quote the last which, as far as I am aware, has taken place, the results of which were kindly forwarded to me. The ranges were taken by non-commissioned officers using the infantry pattern instrument.

Day stormy and a very cold wind blowing. The average error of 16 ranges from 2,000 to 500 yards was '8 of a yard per cent., the mean range 1,200 yards, and time taken 2 minutes.

Another day, when the observations were partly taken during strong wind and driving sleet, the average error was '9 of a yard per cent. in a mean range of 1,365 yards, and time 1 minute 50 seconds.

I have often been asked why I do not employ two instruments or an optical square at one end to get the right angle, and thereby save time. The reason is, that I believe it to be most essential that the same individual should take the observations at both ends; for it is seldom that the objects of which the ranges have to be taken are sufficiently defined to be easily pointed out to another person, and even laying on different points of the same object will sometimes mar the results. I remember one day at Aldershot, in a competitive trial of my infantry range-finder against that of Captain Post, among other objects chosen by the Special Committee of Infantry Officers who were reporting on the subject, was a piece of rising ground on which no distinct objects were visible with the exception of a party of men digging. I selected a small indentation in the ground, which it would have been quite impossible to have pointed out to another individual, carefully keeping it in view while moving from one end of the base to the other. Captain Post, who requires two observers, directed his assistant to lay on the right hand man of the party; but the result showed a considerable error, due to the fact that what appeared to him to be the right hand man was really the second or third when viewed from the other end of the base.

Division B.

Range-Finders for Coast Batteries.

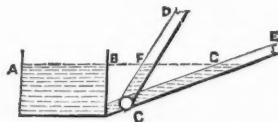
The simplest range-finder with which I am acquainted is what is called the Malta instrument. This consists of a horizontal stone on which is laid a circular racer, in the centre of which is a metal sight. The amount the sight has to be raised, in order just to view the water-line of a ship over the edge of the racer, gives the range. The capabilities of such an instrument are, of course, not very great, even at considerable elevation; but it is probably more reliable than the unaided eye, distance over water being exceedingly deceptive.

A better instrument is the Bell hydroscope, *vide* Plate, Fig. 16, which consists of a galvanized iron tube, about 8 feet 9 inches long, with a

copper cistern at each end. Each cistern contains a zinc float carrying a straight edge on a wire, the stalk being 7 inches high and carrying a steadying weight at the bottom. The tube is let into and secured to a block of wood. To the side of one of the cisterns is attached a brass socket, in which a wooden tangent scale slides, which can be clamped at any height.

Two faces of this scale are graduated in yards for two different heights above the sea-level. To use the instrument a sufficient quantity of water is poured into the cisterns to support the float, the block of wood is placed on the parapet or other convenient resting-place, and the tube directed towards the object the distance of which is to be obtained. From the arrangement of the floats, the straight edges which they carry are always on the same level. The tangent scale then being raised until the object is seen through the slit of the sight to be in the same straight line as the farther straight edge of the floats, shows the distance of the object. This instrument was superseded by one of mine, generally known as the *hydroclinometer*. The principle on which this is based is shown in the following figure.

FIG. 17.



AB is a vessel of water, at the bottom of which is fastened, by a flexible joint, a glass tube CD. The water will rise in the tube to a point F, on the same level as the surface of that in AB. If the tube be now inclined in the position CE, the water will flow to G. The position of the fluid in the tube then becomes a measure of its inclination to the horizon. A sight fixed to a tube of this kind properly graduated would measure the angle of depression and thus give the range. A straight tube without flexible joints would equally answer the same purpose if the whole arrangement were tilted up. Any loss of fluid, however, would entirely upset the graduation on the tube. To obviate this many different plans were tried, all ending in failure, until it struck me that the difficulty could be simply overcome by closing the top of the reservoir by bending the glass tube back again as shown in the figure.

FIG. 18.



This proved most successful, and angles as small as a quarter of a minute could be read off on the tube.

The complete range-finder, see Plate, Fig. 19, consists of such an arrangement enclosed in a wooden frame, fitted with a telescope with cross-hairs and suitable scale, showing angles of depression or scales of yards for different heights of batteries. All, then, that is necessary to obtain a range is to direct the telescope on to the water-line of an object and read the scale of yards. A specially designed slide-rule instantly gives the range for any height of battery from the ascertained angle of depression.

Watkin Depression Range-Finder.

Being much troubled by the shrinkage of the wood in the hydroclinometer, which necessitated the occasional resetting of the telescope, I designed about three years ago another instrument entirely of metal, which, after several trials, has been approved for the Service. It consists essentially of a framework QK, Fig. 20, capable of horizontal movement round a vertical axis KL, supported by three levelling screws LLL. Springing from the framework are two uprights, into which are pivoted two arms EF, CD. A screw H, with drum attachment I, supports the end of the lever EF, the arm CD being held up by the steel point of the slider G. The slider G can be moved into any position along the bar EF, which is graduated to represent height of instrument in feet above the sea-level. A telescope AB, fitted with cross-wires, and a level, M, rests in Y, fixed to CD. It follows, from this arrangement, that any movement of the screw H (and the drum I in connection with it) allows of the levers EF, CD turning on their respective pivots, and inclining the telescope; the amount of this inclination for any definite movement of the drum will depend on the position of the slider G; the nearer this is to the pivot E, the less the angle of depression and *vice versa*. Thus, a scale of yards, representing angles of inclination of the telescope for any definite height, may be engraved upon the drum, and the same scale made available for other heights by altering the position of the slider G. No separate scales are thus required; the instrument is also self-adjustable, and being made entirely of metal is more accurate and durable than the hydroclinometer described above. To take an observation the slider G is moved along the bar EF, to the point representing the height above the sea-level at which the instrument is being used; the drum I is then turned until the cross-wires of the telescope cut the water-line of the object, the reading opposite the arrow J gives the range in yards. Should the height not be known it may be obtained from the known distance of any one object; thus, turn the drum until the distance of the object is opposite the arrow J, then slide G backwards or forwards until the cross-wires cut the water-line, the reading in scale EF gives the height. The instrument can be thus corrected for rise or fall of tide, a difference of less than 1 foot being easily detected. This method of working from a datum distance is the one to be recommended for tidal waters. A few of the actual results obtained with this instrument may perhaps be of interest to you.

Actual distance.		Distance given by instrument.
Yards.		Yards.
665·1	.....	664·5
775·1	.....	774
821	.....	820·5
885·1	.....	885
1017	.....	1019·5
1473	.....	1477
1592	.....	1597
2094	.....	2100

POSITION-FINDERS.

(a.) *Those working with a Fixed Horizontal Base.*

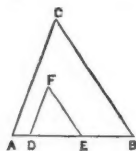
The earliest position-finder of which I am aware is that invented by Mr. Madsen, and used with complete success at Copenhagen during the war of 1864. A full account will be found in the Royal Artillery Institution papers for February, 1866. In this system all the various forts protecting a harbour are connected by a multiple telegraph cable. On each fort is a covered observatory placed in such a position as to command a good view, and provided with a theodolite specially graduated to allow of quick reading. The measurement of the distances is effected by means of a chart, on which the position of the forts and batteries is marked, each having large concentric circles divided into degrees and twelfths. The manner of operating is as follows:—A fort points out an object, and makes known its position by telegraph. The principal station details the two forts that are to observe, and also the one that is to direct and indicate the moment of observation in the case of the object being movable. The observers announce when they have found the object, point at it, and read the angles to the telegraph operators, who transmit them to the other stations, where by means of the threads and divided circles they are laid down upon the chart.

A point of intersection is thus obtained which represents the position of the ship or object at the moment of observation, and, after having marked this point in pencil, its distance from the fort or battery is measured by a divided scale, graduated so that distances of 25 feet can be read off with facility. At the fort the distance thus found is communicated to the casemate battery by means of an acoustic tube.

Such a system requires a good many skilled operators, and great care has to be exercised that the observations at the two stations are made at the same moment. A great many operations have to be gone through—telegraph messages have to be transmitted and deciphered, and the sides of the triangle have to be plotted before a range is determined. A failure in any one of these operations vitiates the result. In order as much as possible to curtail the various operations, I submitted, in 1867, a design for a position-finder, which worked automatically by means of mechanism actuated by electromagnets; but it was not till 1875 that facilities were afforded me of practically exhibiting the advantages of such a system.

The mathematical principle on which the instrument is based is that of similar triangles. Thus, in the triangles ACB , DFE , if DF is parallel to AC , and FE to CB , these triangles will be similar to one another in all respects. Suppose A and B two stations 1,000 yards apart, D and E the representatives of them on any scale, it will follow that the position of a vessel C would be truly indicated on the plan at F .

To carry this idea into practical effect, automatic instruments of my design are placed at A , D , E , and B , similar in their electrical and



mechanical construction, with the exception that those at A and B carry sights, those at D and E long aluminium arms. The instruments A and D are connected by an underground cable, and in a similar manner the instruments B and E . The mechanism that actuates these sights and arms is set in motion by currents of electricity sent into it from a voltaic battery by means of a transmitter. This transmitter is so arranged that, on turning a handle in one direction, the sight and its corresponding arm moves from left to right; if the handle be reversed, they move in the opposite direction. By this means the sights can be made to follow all the movements of a ship throughout her track, and as the arms at the same time keep parallel with them, their intersection gives the course of the vessel.

To enable the position of the object to be readily indicated, the plan of the waters covered by the fire of the fort is divided into squares, each square having a distinguishing number and letter. The range, training, and quadrant elevation necessary to throw a shot into the centre of each square is tabulated for every gun or group of guns, thus:—

<p>B 2365 83½ 3·46</p>

B. The distinguishing letter of the square.

2365. The range in yards to centre of square.

83½. The training on arc necessary to point the gun in the direction of the centre of the square.

3·46. The elevation necessary to be given by "index plate" and "reader" to give a range of 2,365 yards.

This information allows of practice being carried on under the following conditions:—

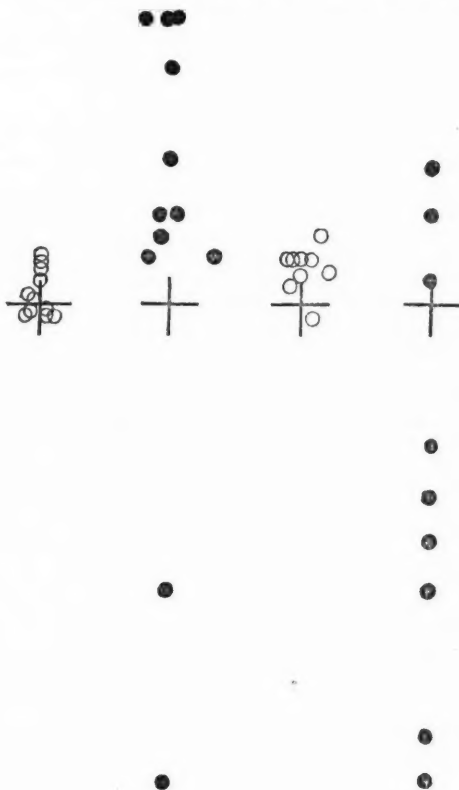
1. When the object is visible from the battery, and the range only required.

2. When the object is invisible, owing to the smoke or other causes, the gun being laid by arc and index plate.

3. When a concentrated fire is required, the position of a vessel may be predicted some minutes in advance, and the guns laid on a square over which she must pass.

The number of the square in which the object is situated is automatically transmitted to tell-tales, or range dials, close to the guns; see Figures

Practice under present service condition shown ●
Practice with the aid of the Position-finder shown ○



Such is a very brief outline of the system which, after very successful preliminary trials at Sheerness and Shoeburyness, was finally set up at Picklecombe Battery, and thoroughly tested by actual practice at a moving target towed across the range. Although the men who manned the guns had less than ten hours' instruction in the system of laying, most satisfactory results were obtained. Advantage was taken of these experiments to test the relative value of the fire of a fort when worked in the ordinary manner without instrumental aid and with the position-finder. The results, which speak for themselves, are graphically shown in the diagram. The targets are here represented as stationary, but were in reality constantly manœuvred in a zig-zag course in front of the battery at rates varying from 5 to 7 knots an hour.

It must be remembered that the practice with the position-finder here depicted is what is sometimes called "blind shooting;" that is to say, as far as the men at the battery are concerned, the target was invisible. This is one of the practical advantages of a position-finder, for the smoke often hangs about a fort and prevents anything being seen from the guns.

I must ask you, in looking at the diagram of practice under Service conditions, not to blame the artillery. They do all that men can do. Believe me, it is impossible to judge distances over water, more especially when all the out-look we have is a small opening in an armour-plate, when no shore or surrounding objects are visible to aid the eye. We must look the facts in the face, and not delude ourselves with thinking that, should the time ever come when our guns have to fire in earnest, they will make the shooting that they do at Shoeburyness, where they are manned by a picked detachment and the range is measured to a yard. No, gentlemen, what I show you in the diagram (the result of a fair and practical trial) is what may be expected unless some such system as I have been describing be fitted to all our casemated forts. With such a system, and with the aid of a few trained men, no skilled marksmen are required at the batteries; and a detachment of intelligent men who know how to load and fire a gun can be trained in a few hours to make good and certain practice.

Surely the paltry sum that is required to set up and organize such a scheme should not be grudged, when, without it, the millions spent on our forts and their equipments are comparatively valueless.

One disaster has at last opened our eyes to the fact that something more than the mere possession of a straight-shooting rifle is necessary. I trust it will not require another to convince us that, although we possess magnificent forts and hard-hitting guns, we yet lack the one thing needful to make these of any avail.

Depression Position-Finder.—About four years ago it occurred to me that an instrument might be constructed that would give the exact position of an object, but which would only require one operator and one observing station, instead of two as in the electric system just described. After various attempts I at last succeeded beyond my most sanguine expectations—an accuracy equal to that of my Depression Range-finder being obtained (see page 780).

Another instrument based on somewhat similar principles has also proved very successful at some recent practical trials at Pembroke, when used for submarine purposes. The trials showed that the instrument is capable of automatically connecting up and exploding ground mines within less than 3 yards of vessels moving at a speed of 7 to 8 knots an hour. I regret that I am unable to show you these position-finders, or even to explain the principle on which they are constructed, as I have been requested to keep them strictly confidential. They have only been brought to your notice to show what has been accomplished in this direction.

The CHAIRMAN: There are many gentlemen here intimately acquainted with this subject, who will no doubt favour us with some observations upon it. Perhaps Major Nolan, as he may be considered to some extent the father of this branch of military science, will give us some explanation of his views upon the subject.

Major NOLAN, R.A., M.P.: I can hardly acknowledge the paternity with which you credit me, as I believe General Clerk was the first who took up the subject. I think, however, that I express the feelings of the meeting when I say that we have been singularly fortunate to-day. I do not think that at any time there has been such a collection of good instruments brought together as we now see before us, and I am sure every one here will join with me in saying that it is very unlikely that such a lucid expounder of these instruments as Captain Watkin has been, will be found very easily again. Those who are at all acquainted with the subject must acknowledge that Captain Watkin has very nicely apportioned his observations to each instrument, and has carefully explained to us in considerable detail their leading features. I have very little to say on this subject, except to make a little disclaimer about that instrument before you, which is not exactly my design; although the main part is mine, there were a great many additions made, and there are no less than four additional movable screws or parts in it which I have always thoroughly disliked, seeing that they spoil the simplicity of the instrument and add considerably to its weight. I have always thought the instrument would have worked much better without them. If I were making an instrument now, I should have a very much more powerful one with a very much smaller base; that is my idea at present. I think we all regret that Captain Watkin finds it necessary not to tell us about his new position-finder, which I believe I know indirectly to be a most valuable instrument. I hope some day we shall be able to see it when all the arrangements connected with it are concluded. I am sure we must all thank him for the very good lecture he has given us.

Lieutenant EDWARDS, R.H.A.: Although no efforts have been spared to provide the Service with a serviceable field range-finder, it is incontestable that the performances of the instruments hitherto have been unsatisfactory. The reason probably is that instead of fitting the range-finder to the Service, inventors have endeavoured to fit the Service to the range-finder, just like indifferent shoeing-smiths try to fit the horse's hoof to the shoe, instead of the shoe to the hoof. The Service range-finders are chiefly objected to as being too complicated and delicate. Therefore let a rough and ready instrument be supplied, which will at least convince artillerymen that range-finding is practicable and useful. In course of time instruments requiring more delicate manipulation may be introduced. If any instrument can be found to find ranges within 50 or 100 yards quickly and readily, it will do to begin with. Such an instrument is my own, which lies on the table, though it has its faults, as I am well aware. Under favourable circumstances it will find ranges fairly accurately; you can drop it on the floor without damaging it. There are no screws to work or scales to read, and, what is of far greater importance, men take to it, like it, and soon learn to work it well. If a higher class of instrument is required, I advocate Major Nolan's field range-finder worked with a base of 10 to 20 yards; one instrument attached to the gun and capable of being used as a telescopic sight, the other instrument on a tripod. Every gun should have a complete set, and the ranges should be found by the man who lays the gun. The

process of finding the range would actually lay the gun as far as direction is concerned, if the instrument on the gun is used as a telescopic sight. With regard to teaching the art of range-finding, I believe that it will be found necessary to teach the subject specially, like riding, musketry, and signalling. If Officers are not considered competent to instruct their own men in these subjects, they can scarcely be expected to make their men proficient in the art of range-finding, though it is probable that a short trial would prove that Officers are competent to teach their men *everything* that is required of them as soldiers, without the assistance of riding-masters, musketry instructors, and schoolmasters of all denominations. Officers and men would both become more efficient, and when the time comes for this happy change there will be no necessity for examinations, because the efficiency of the Officer will be self-evident from the state of efficiency of his men.

Major WACE, R.A.: I was on service in Southern Afghanistan for two years; the first year we had no range-finder, but the second year we had Captain Watkin's range-finder. During the first year I can certainly say I often felt the want of a range-finder, for it is far more difficult to tell ranges in a mountainous country than in a plain country: in fact it is one of the most difficult things that I know. We used to do the best we could with a sextant, and so we went on for a year. After that we got Captain Watkin's range-finder, and worked it the whole of the time I was with the battery. There is one thing, however, that I am sure Captain Watkin will not mind my referring to, and it is this, that we found it very difficult to arrange the flags on very hilly and stony ground. The mountains in Afghanistan are so covered with immense rocks, and the ground is so very hilly and difficult, that we frequently got into positions where it was impossible to get the flags into the same plane. I do not perhaps mean to say that it was absolutely impossible to do so, for I believe Captain Watkin says that it is always possible, but it is very difficult; and sometimes we found that we could not afford the time required. In mountain warfare you have to be so very quick, you can only catch your friends for two or three minutes, and then they are gone; so that we could not give the time required to use the range-finder. It might perhaps have been done in a minute or a minute and a-half, but I found I could give them two or three rounds in that time. Captain Watkin has not only produced that range-finder, but there is the depression range-finder, and I believe there are a half-a-dozen more in Captain Watkin's brains that he has not told us anything about. I only hope in the course of time he will give us a range-finder for which we shall not have to use flags; no doubt he will be able to provide us with such an instrument; and I am quite sure he will forgive me for pointing out the real difficulty that we experienced in using the one that we have at present.

Captain SAUNDERS, R.A.: I wish, as an Instructor of Gunnery at Shoeburyness, to bear testimony to the excellent work we have done with Captain Watkin's field range-finder, which we use very considerably. We have a great many courses of non-commissioned officers passing through every year; nearly all of them learn it, and, as a rule, they pick it up very quickly and work it very accurately. It is idle, however, to deny that there is a good deal of talk amongst Officers of the Royal Artillery and the rest of the Service about the instrument. Some of the objections urged are no doubt frivolous. Only last week I heard one Officer say, "If the instrument fell on the ground and a horse trod on it, it would be of no use." What instrument would be of use under such circumstances? Another Officer complained that if he jumped a fence the instrument hurt his shoulder. But that depended on how he carried it. One Officer, in his practice with the Horse Artillery last year, said he would rather be without a range-finder at all. I think that Officer's battery will very shortly be armed with 13-pounders, and he will find it absolutely necessary when he goes to shoot with the 13-pounder to have a range-finder. I do not think the human eye has ever yet been made that can estimate ranges with sufficient accuracy at 4,000 yards to fire a common shell at an object, and it will take a great many trial shots at 4,000 yards, or even shorter ranges, to put a common shell into an enemy's gun-pit; whereas if you have an instrument like Captain Watkin's, you get the range of that gun-pit before opening fire, and probably you put the first shell into it. There is one suggestion I would make, as the instrument is very constantly liable to fall into the hands of half-trained men in the battery in conse-

quence of the proper range-finding men being away ; it frequently happens that as the best range-finders in the battery are absent from various causes, the next best men are taken to observe the range, and as a rule the range obtained is not the right one. I find that the error lies generally in getting the base. I therefore propose, with a view of eliminating all possible error in getting that base by reflection, to introduce a tape. I believe Captain Watkin does not like the word "tape," but only last week we had a battery at Shoeburyness and they told me their range-finders were going through a course, but they had some men who had used the instrument. They set to work to take the range ; it was taken by several men, and no two men agreed. The range was only 1,000 yards, but some of the men were 80 or 90 yards out. In the right-hand triangle, shown in the diagram (Fig. 15), in taking the base the observer at B looks at C and D, and he sweeps the D picket on to the C by a motion of the screw. A great deal depends on the background which there is to C and D pickets, and on the state of the atmosphere ; a great deal also on the personal error of the men, because very often men vary. One man will take the instrument at B, and say he has the D picket covering the C, and another man will say, "I do not agree with you ; I can see half of the C picket ; it is not covered at all." And sometimes it will occur that, although you can see the C picket, you cannot see the D picket, owing to a hollow in the ground. I tried what I proposed the other day with a highly skilled non-commissioned officer at Shoeburyness. We were working against time, and he took the range of an object at about 1,000 yards off in 1 minute 18 seconds, and made it 1,030 yards. I asked him what base he had. "68 yards." I said, "Take the tape and measure the base." And he made it 66 yards. I then got the right range with a base of 66 yards, and made the real range 995 yards. This was a very highly trained man, and he was 2 yards out in his base ; therefore I say in a battery which has half-skilled men to work with, it is desirable to have some means of getting that base very accurately. Of course it *can* be obtained by reflecting the picket D on to C, but as a *subsidiary expedient*, in my opinion, it would be an excellent thing to have a tape, to be used when you cannot quite rely on the men who take the range. Otherwise I think the instrument is nearly perfect. The difficulty of getting the right angle at B and the range at C is almost *nil* ; the only difficulty in working the instrument is in getting the base and sweeping the D picket on to the C.

General SIR W. CODRINGTON, G.C.B. : I should not have risen on a question of artillery detail, although this is evidently one of the most essential, but it is also a question for a General Officer in command of troops. The time required to get the range is occasionally all-important, and therefore I presume the object must be to get the range accurately in the shortest possible time. A battery is probably kept out of fire until the moment it is wanted ; it is then pushed forward quickly to the position chosen ; and if, as I understand, it becomes a delay of two minutes, the opportunity may often be lost for firing at infantry effectually, unless it can be done within those two minutes. I therefore suggest that this should be considered not simply as a question of artillery detail, or for artillery only, but also as one that may influence the dispositions of a General Officer in command of troops in action.

Captain WATKIN : With regard to Lieutenant Edwards' observations regarding a simple range-finder, it must be remembered that not only must the simplicity of construction of the instrument be considered, but the many other points which go to make up a serviceable range-finder, that being selected which works best under all the varying circumstances met with on service. I must apologize to Lieutenant Edwards for not describing his instrument during the lecture, but the details were given me too late to insert in my notes, and I regret it was in consequence overlooked. Major Wace has mentioned how difficult it was sometimes in Afghanistan to get a base for my range-finder ; as this works with any base from 30 yards to 200 yards, it shows how impossible it would have been to have worked with an instrument requiring a base varying in proportion to the range as in Lieutenant Edwards' instrument. In fact, it is impossible to fulfil all the conditions required in a service range-finder by the extremely simple means suggested by that Officer. With regard to the difficulty of driving the steel pickets into the ground ; I am happy to say that in the latest pattern equipment this is entirely got over

by the introduction of this tripod picket, which will stand on any ground. I could hardly conceive it possible not to be able to take a range on any ground at all practicable for artillery; as the distance between C and D is only 6 yards I should have thought there would have been no difficulty. In extreme cases the base might be measured as suggested by Captain Saunders, or the difficulty might be met by the use of this instrument (which I have not yet submitted), which has the advantage of looking without the necessity of laying off an exact right angle, and requires no adjustment. As to some remarks that have been made as to the difficulty of instructing men, I can only say I myself have found none, a large number of the men learning in one day and all within a week. If the advantages of a range-finder are not considered worth the trouble of a week's instruction, it would be far better to dispense with them altogether. Look at the time and care devoted in teaching men to signal, or blow a bugle; anything like the same attention to range-finding would produce excellent results. Officers should not condemn range-finders because men who have passed through a course and are supposed to be instructed are found unable to take a range correctly. I have found such who could only just read the drum, and declared they had never been taught anything else. At Plymouth a sergeant gave himself out as capable of instructing a class in the use of the range-finder, whose only acquaintance I found with the instrument was the fact of having seen it in store at Bombay. Such, gentlemen, are some of the difficulties one has to struggle against. Naval range-finding is a most difficult problem, and one I have hitherto refrained from attempting, with the solitary exception of an instrument made to work from the cross-trees. Captain Saunders remarked that he had found a difficulty in teaching men to get the base correctly; to show how opinions differ I may mention that I have been often told this was the most accurate part of the instrument. As nothing helps in invention so much as pointing out defects, I must thank Captain Saunders and others for their suggestions. I think from Captain Saunders' account the men could not have been sufficiently conversant with the use of the instrument to judge whether, with properly instructed men, it would be advisable to go back to the primitive method of measuring the base with a tape. As far as my experience goes, I think men can be taught to measure the base with only an error of half per cent.

The CHAIRMAN: Gentlemen, I think we are all deeply indebted to Captain Watkin for the excellent lecture he has given us, and for having collected this magnificent collection of range-finders of all sorts for our information. One or two points have struck me in what has passed, upon which perhaps you will allow me to make some short observations; and first, I would remark upon the difficulty of judging distances in different countries. Our eyes get used to the objects which we see around us, and in strange countries in which troops may be acting the ordinary objects may be different to what we are accustomed to, and the consequence is we are at a loss in judging range. A remarkable instance of that was brought to my notice a short time ago by a sporting gentleman who was on a shooting expedition in Africa, who found he could hit nothing. He took a Dutchman out with him the next day, who judged distances for him, and as a consequence he had a very good day's sport. The objects around him and the haze there was over the velt were such as he was not accustomed to, and his sight not being trained to them he could not judge ranges. One often hears of trial shots. I do not myself believe much in trial shots unless at a living object. If you get one at a living object you soon see the result, but otherwise with a trial shot at a long range, you may watch it as closely as you like, and I do not believe at 2,000 yards for instance the human eye can detect whether it falls 100 yards short or 100 yards over, or even much more than that. When you look over a plane the angle subtended by the space of 100 yards in a direct line towards you at the distance of 2,000 yards is so small that the human eye cannot detect it, and therefore I do not believe much in trial shots unless at living objects. It is absolutely necessary for us, therefore, to have range-finders, notwithstanding individual and other errors, such as have been alluded to. They would also be of great value for instructional purposes. If men were constantly practised in judging distances, and the distance afterwards ascertained by range-finders with a view to correcting their judgment, I believe much greater accuracy would be

acquired in the judgment of ranges. This is the more important because in infantry operations personal judgment is almost the only way of getting at distances in action; the objects so constantly change their position and so rapidly that there is little chance of ascertaining ranges instrumentally. As regards artillery I think the country and the profession are greatly indebted to Captain Watkin for what he has done, and to Major Nolan also, who explained his instrument to me many years ago, when he was working at range-finding before Captain Watkin had taken up the subject. I have seen Captain Watkin's arrangement for position-finding at work at Plymouth, and I must say I think it is one of the most beautiful arrangements for finding ranges by the aid of electrical means that is conceivable. The operation is one which admits of very great accuracy, and the training of the men takes but a short time. If the points from which the observations are taken are well determined and at a considerable distance from one another, the position of the objects to be fired at is ascertained with perfect accuracy, independently of smoke. If you enter one of these large casemated batteries and attempt to look through an embrasure with a big gun in it, with a view to following an object, it will be found that the space through which you look is so small, and you see very few objects in the neighbourhood of the one you are particularly observing, that it is exceedingly difficult to judge the range, and a very little smoke stops all vision from the battery. Therefore, I think it is of the utmost value that you should have an instrument which makes you independent to a great extent of smoke, and enables you to lay your guns with accuracy. The value of a single shot from those guns is not only great from the money point of view, but also of infinite importance as to its results. The guns are slow to load, and if a shot be thrown away you may not get the chance of repeating it. It is, therefore, of the utmost consequence that when your batteries do open they should open with a known range, and therefore we cannot be too grateful to Officers who take the trouble to take up these important questions, and endeavour to bring them to a satisfactory issue. As regards instruction, I would venture to make one or two observations. Instances have been mentioned of sergeants and non-commissioned officers coming forward who know very little about the instruments for the use of which they volunteer themselves as instructors. I am one of those who believe that if our Army is to keep its place, the proper instructors in all cases are the Officers. The Officers themselves ought thoroughly to know every instrument with which they are charged, and it is their duty to teach their non-commissioned officers, who afterwards repeat the instruction to those below them. I do not believe in special instructors for particular purposes. The appointment of special instructors to teach this or any other branch of duty would take the responsibility from the Officers in charge of batteries and throw it upon others, whereas if an Officer has the interest of the Service at heart he ought to be jealous of anyone interfering to give instruction to his men. It should be his duty, as well as his greatest pleasure, to instruct his men. That is an opinion which I have formed after seeing what is done in the other Services. I know that in the German Army instruction is carried out to the last extent by the Officers in immediate command of the troops, and that no instructors step in between them and their men, for whose instruction they are held responsible. I have now only to request that you will allow me to return your best thanks to Captain Watkin for his admirable lecture.

Friday, July 1, 1881.

GENERAL SIR WILLIAM J. CODRINGTON, G.C.B., &c., &c., &c.,
Vice-President, in the Chair.

THE AUSTRIAN ARMY; MORE ESPECIALLY WITH REFERENCE TO THE MILITARY TRAIN, AND THE ORGANIZATION OF THE LINES OF COMMUNICATION IN THE FIELD.

By JOHN ROSS-OF-BLADENSBURG, Coldstream Guards.

THE subject which I shall have the honour of bringing before your notice to day is one which cannot easily be dealt with in the short space of time at my disposal, and I do not therefore propose to weary you with any long preamble. All I would say is, that the Austrian Army, in my opinion, is a most interesting study; exhibiting as it does the armed forces of a great military Power which is composed of a conglomerate mass of many nationalities, more divergent in their ethnographical peculiarities than any other State, always excepting the Ottoman Empire and Russia; and, unlike either of these latter, giving a freedom to each section of her population which can perhaps be best appreciated in this country. On purely military grounds, this Army demands attention, for considerable care has been bestowed upon its development within the last ten years, and because it is one of the European military Powers that has played, and that will play, a very important part in the world's history.

I propose to describe only briefly the general organization of the fighting branches, because, as there are rumours afloat that some very radical changes are in contemplation, I should be wasting your time in going into that which in a few months will probably be altered. The Military Train, however, has recently¹ been remodelled, on principles laid down by a Committee which sat shortly after the Bosnian Campaign, to enquire into the defects of the Army as then exhibited, and to propose those reforms which practical experience had suggested. I would therefore draw your attention to that service; and also to the manner in which the lines of communications are organized in the field, because this, too, has been lately² improved, and because it is in some way connected with the Train. I can only hope that these points will be the more interest-

¹ April 1880.

² July 1878.

ing, as they are matters which have occupied the attention of military circles in this country.

The military law in force dates from December 1868, and by it those men found fit to serve in the Army and Navy are divided into three categories.

1st category for the standing Army and Navy.

2nd " " Ersatz Reserve.

3rd " " Landwehr.

The 1st category is composed of the yearly contingent of recruits, and amounts to 95,474 men; they serve three years with the colours, seven years in the Reserve, and two years in the Landwehr.

The 2nd category is formed by a yearly contingent of 9,547 men; they serve ten years in the Ersatz Reserve, and two years in the Landwehr.

Into the 3rd category are drafted the remaining men of the year's levy; they usually amount to 20,000 men annually, and they serve twelve years in the Landwehr.

The Reservists are called up to three periods of drills¹ during their term of service, each to last four weeks. The Ersatz Reserve have not hitherto been regularly trained; it is contemplated, however, to give them eight weeks' drill. Landwehr recruits receive eight weeks' training (in the cavalry, three months); afterwards the first six classes are called up every year for a fortnight or three weeks, and the other classes every second year for the same period.

Deducting 4 per cent. as the annual loss, we have:—

						Men.
3	classes,	1st	category,	under the	colours	.. .. 275,000
7	"	"	"	Reserve	.. ..	525,000
Total (established by law)						.. .. 800,000
10 classes, 2nd category, Ersatz Reserve						.. .. 80,000
2	"	1st	"	Landwehr	.. ..	122,000
2	"	2nd	"	"	.. ..	12,000
12	"	3rd	"	"	.. ..	207,000
Total Landwehr						.. .. 341,000
" Ersatz Reserve						.. .. 80,000
" Active Army						.. .. 800,000
Grand Total						.. .. 1,221,000

From this we must subtract nearly 14,000 men for the requirements of the Navy, leaving more than 1,000,000 men for the land forces of the Empire.

The Landsturm has not yet been regularly organized, except in the Tyrol and Vorarlberg, where this has been only partially done. Nominally, however, it is composed in the rest of Austria of all men

¹ A *projet de loi* is proposed, by which the Reservists may be called up to more than three periods.

not belonging to any other portion of the armed forces, and of Volunteers in Hungary. It is now proposed to establish it definitely throughout the whole Empire.

A military tax has been lately enforced upon those who are unfit to serve (although not to work), upon emigrants, and upon those who are exempted from serving for family reasons. This tax varies from 1 to 100 florins annually, according to the wealth of the person who has to pay it, and the money produced is devoted to the support of widows and children of soldiers killed or wounded in war time, also to assist needy families during a mobilization.

Bosnia and Herzegovina are to be drawn upon for recruits; the new arrangement is that a yearly contingent of 20,000 men will be raised by *quasi* voluntary enlistment, and the first levy is to be made this year. It remains to be seen how the War Ministry will deal with these men; for no separate regiments are to be formed. It cannot be doubted, however, that they will eventually form a considerable increase to the Imperial forces when the system has been in force some few years.

The Dual Monarchy is divided into eighty-four recruiting districts, of which three belong to the Navy, and eighty-one to the Army; of the latter eighty furnish men to the eighty infantry regiments, one of the former being allotted to each of the latter, while the Tyrol and Vorarlberg forms a special district, and recruits for the Tyrolese Rifle Regiment alone. The eighty recruiting districts supply men to the remaining portions of the Army according to a definite plan.¹

In peace time the Imperial forces are formed into certain Service and Reserve units as well as Cadres; and these are brought up to the war strength by the Reservists, while the Cadres usually expand into other units. In every case when the depôts are mobilized, a subunit remains behind to receive recruits and remounts, to train them, and to push them to the front, according to requirements at the seat of war.

1. The Infantry is divided into infantry of the line and the rifles.

(a.) The Infantry of the Line is composed of eighty regiments of five battalions each, and a depôt battalion. In reality they each form two ordinary regiments, the first consisting of three field battalions, which are mobile; the second of two reserve and the depôt battalion, which remain in the recruiting district. All except the depôt are divided into four companies, and the depôt has five. On mobilization, the field and reserve battalions are brought up to their war strength, and may act separately as two regiments; in cases of emergency, four companies of the depôt are also mobilized, forming a sixth battalion. Total infantry of the line would therefore amount to 480 battalions.

(b.) The Rifles comprise the Tyrolese Rifle Regiment and the Field Rifle Battalions. The former is made up of ten battalions and of ten depôt companies which expand into two more reserve battalions, leaving a depôt behind as before. The latter are made up into forty field battalions, and as many depôt companies which when augmented form ten extra battalions. Thus we have 62 rifle battalions.

¹ Laid down in the "*Instruktion zur Ausführung der Wehrgesetze*," 2nd Edition, 1867.

2. The Cavalry is composed of forty-one regiments, to which it is expected that shortly two more will be added. Each consists of six squadrons, a pioneer section, and a *depôt* cadre, which in war time expands into a reserve squadron, one troop for orderly duty, called *staff cavalry*, and a *depôt*.

3. The Field Artillery is organized into thirteen regiments of four divisions of batteries each, with a *depôt* cadre. In war time these expand into five divisions in eight regiments, and into six divisions in the remaining five regiments, the 6th division being Horse Artillery. Each regiment, moreover, has six ammunition columns.

There are also twelve battalions of Fortress Artillery, of five service companies, and one in cadre which forms a sixth in war time. And several Mountain Artillery batteries are formed, of which some already exist in peace time, to be expanded into a greater number on mobilization.

4. The Engineers are formed into two regiments, of five battalions (four companies per battalion), eight reserve companies and a cadre; from the latter, nine mining detachments are created from one regiment, and six from the other.

5. The Pioneers are a special feature in Austria; their duty, more especially, is to construct, repair, and destroy all means of communications, such as railways, telegraphs, roads, and bridges. They consist of one regiment of five battalions (four companies to a battalion), five reserve companies, and five cadres, whence fifteen detachments are produced, which in war time are joined to the fifteen mining detachments, and form the military portion of the railway field sections. Each battalion, moreover, has eight bridge trains which are horsed by the Military Train, while others are in store for the reserve companies, should they be required.

It is in contemplation to amalgamate the Engineers and Pioneers into one service, and to call the whole the "Pioneer Corps;" but this organization has not yet been issued.

Before proceeding to the Military Train, I must draw your attention to certain points connected with the above troops which are well worthy of consideration.

First.—The infantry (Line and Rifles) are provided with the portable infantry spade (see Figs. 1 and 2). The pattern used is that patented by Captain Linnemann, and it is carried by every man in the rear rank. The regulations for its use are dated 1873. This small and light entrenching tool has done considerable service, not only, as will probably be remembered, by the Roumanians at Plevna (who have got the portable spade), but also by the Austrians in the Bosnian Campaign; during the latter operations, Szapary's Division, which was acting independently, and which received a check from the Bosniacs, found the greatest advantage in the use of this spade, and it is really astonishing what it accomplished.¹

¹ Those interested in this important matter should consult "*Ueber die Anwendung des Infanterie Spatens vom Standpunkte des Infanterie Offiziers*," by Moriz Ritter von Brünner. 2nd Edition, Vienna, 1880.

FIG. 1.

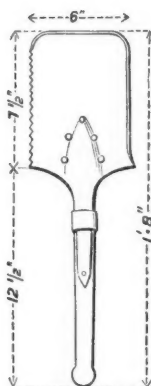
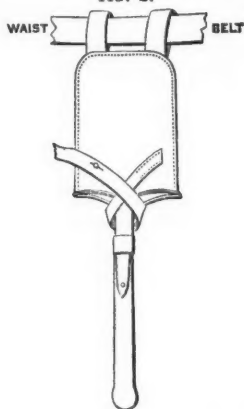
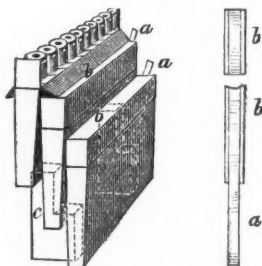


FIG. 2.



Second.—The ammunition pouches (see Fig. 3) in use in Austria deserve mention; the expense pouch—so to speak—is worn in front, and contains thirty rounds; it is provided with three little leather steps (c), upon each of which a packet of ten rounds rests. The cartridges are so packed in the latter, that when you tear off the upper part by a ribbon (a) the sides fall down, and each cartridge can then be easily extracted for use. All the small arm ammunition is packed in this way, and can be more readily got at by the soldier, than where the cartridges are so carefully enveloped in paper wrappers.

FIG. 3.



Third.—I must notice the care that prevails in Austria to preserve the full complement of men in the ranks, and not to fritter them away in other duties, which often impair the fighting strength of the Army. I have drawn out a table¹ showing this, and it will be observed that

¹ Table No. 1.

Officers' servants, carriers for the wounded, drivers, &c., do not belong to the fighting effectives of the battalions, and they are classed as non-combatants. In the Cavalry, where the latest improvements have been made in the recent organization,¹ this is, perhaps, shown clearer. In this regulation, it is laid down that the six squadrons should be as strong as possible in the field, in order to carry out those duties which essentially belong to that arm of the service. For this purpose the reserve squadrons previously spoken of may be used in fortresses, and on the lines of communication, while the "Staff Cavalry" troop is to be employed in furnishing mounted orderlies at the head-quarters of Generals who are entitled to them. The Pioneer Cavalry section is also over and above the six service squadrons, and the only duty the latter is called upon to fulfil is to supply a few men for mounted military police.

Fourth.—Every regiment or independent battalion of infantry, squadron of cavalry, battery of artillery, &c., has belonging to it, on a war footing only, a special transport of its own for its baggage, and for supplies that would be immediately required. I will take the infantry as an example.²

Every field regiment has four wagons, two for meat, and two for baggage, clothing, reserve biscuit, &c. Reserve regiments have only three. Every battalion has two ammunition wagons, a market cart, two wagons for spare boots, clothing, Officers' baggage and reserve biscuit, and three provision wagons with two days' rations.

The train is divided into several portions.³

1. The ammunition wagons always follow the troops and march at the tail of the regiment.

2. The meat wagons and market carts go next, and remain as near as possible to the troops under a sergeant; they form the *Fighting Train*.

3. The clothing and baggage wagons follow; and next come the provision wagons, together with fifteen head of cattle. They form the *Baggage Train*, and may be separated from the troops. Also the provision wagons are often employed as the connecting link between the regiments and the columns of supply of which we shall hear further on.

The *Fighting* and *Baggage Trains* are technically called the *Small Train* under the regimental Provision Officer.

The men carry two days' rations (excluding meat), and one reserve or *iron* ration; also seventy rounds of ammunition. By the assistance of the regimental train, the supplies are bought up to four days' complete rations, together with reserves in sausages and in biscuit; also the ammunition wagons carry fifty-three rounds per rifle; or a total of 123 rounds, in each man's possession, and in the battalion ammunition wagons.

I now come to the Military Train.

This is divided into a Transport Corps (*Train Truppe*), and into a Transport *Matériel* Department (*Train Zeugs Wesen*). I need not say

¹ 10th May, 1881.

² See Table No. 1.

³ See Plate.

much about the latter; it is similar to the Technical Artillery Department, and to the Pioneer *Matériel* Dépôt, both of which are established for the purpose of manufacturing and storing *matériel* for their own arms of the service. The Transport *Matériel* Department expands like the Technical Artillery on mobilization into certain units, who, upon the lines of communication, repair and issue to the troops in the field the stores of which they have the custody.

The Transport Corps (*Train Truppe*) is divided into three Regiments, each having four or five Divisions (numbered from 1 to 13), and a dépôt cadre. The Divisions, moreover, are divided into a certain number of Train Squadrons (numbered, irrespective of regiments and divisions, from 1 to 75), Mountain Squadrons, and a Park Cadre. There are at present only seven mountain train squadrons formed, but there are finally to be twenty.

In peace time the Military Train exists little more than in cadre. The squadrons have each only 24 Officers and men, 16 horses, and three wagons; the remaining units have no wagons at all. On a peace footing, the three regiments comprise 234 Officers, 2,049 men, 1,271 horses, and 300 four-horsed wagons. Recruits are enrolled by Divisions, and are taken from certain districts mentioned in the instruction for carrying out the military law. In war time, however, the Reserves belonging to the military stud establishments, and a certain portion belonging to the cavalry, are also called up, together with the Military Train reserves, and serve in that arm; and the war strength of the three regiments includes 800 Officers, 34,200 men, 43,353 horses, 1,383 two-horsed, and 7,611 four-horsed wagons.

On mobilization, the regimental dépôts expand into—

- (i.) A Train Park for an "Army."¹
- (ii.) Sections of Military Train for fortresses which may be threatened by the war.
- (iii.) Mountain squadrons which may be required, but for which no cadres exist at present.
- (iv.) A dépôt to train recruits, to break in horses, and to send them to the front when wanted.

The Park Cadres expand into—

- (i.) A Train Park for an Army Corps.²
- (ii.) A Section of Military Train for a Field Supply Magazine.³
- (iii.) A dépôt for sick horses.

The seventy-five squadrons are thus allotted to the Field Army:—

Nos.	1—42	Squadrons, one to every	Infantry Division. ⁴
"	43—47	"	"
"	48—60	"	"
"	61—63	"	"
			Cavalry " ⁵
			Army Corps. ⁶
			Army and Army General Command. ⁷

¹ See Table No. 7.

² See Table No. 7.

³ See Table No. 8.

⁴ See Table No. 2.

⁵ See Table No. 3.

⁶ See Table No. 4.

⁷ See Table No. 5. For explanation of the "Army General Command," see further on.

Nos. 64 Squadrons to the Commander-in-Chief's Head-Quarters.¹

„ 65—75 „ one to every four bridge trains.²

These squadrons are divided into a certain number of Sections³ (*Züge*), and their duty is to transport the head-quarter staffs to which they are attached, viz.: the telegraphs, post, military chest, printing presses, head-quarter baggage, &c. Also the sanitary establishments belonging to their own special army units, and the supply columns belonging to the same. They have also to superintend the civilian or hired transport: and in those squadrons assigned to the bridge trains, to horse and to drive them (the pioneers find their own wagons, &c.). In other words, the squadrons of Train perform the same duties for the Divisions, Army Corps, &c., that the regimental transport previously described do for the regiments.

The Army Corps Train Parks are established for the purpose of replacing and supplying the squadrons in the Army Corps with men, horses, and train *matériel*, also to supply horses, wagons, harness, &c., to the regimental transport.

The Army Train Parks renew and supply the Army Corps Train Parks, and those squadrons and Train sections which do not belong to Army Corps, with men, horses, and *matériel*; the two former they receive from the regimental *depôt*, the latter from the Transport *Matériel* Department or from the Army Field Train *Depôt*, which this department establishes upon the lines of communications. These parks also have generally a small detachment belonging to the *Matériel* Department, to assist in repairing, &c.

At the head of the whole Austrian Military Train is a General Officer called the Inspector-General. He is at the War Office, and his duty is to inspect the regiments and to act as the Staff Officer of the War Minister in matters affecting the Train.

During a war the commanders of Train Regiments act as the Inspectors of Military Train on the lines of communication of an army, while the commanders of Train divisions act as Inspectors of that which belongs to an Army Corps; these Officers are responsible, within their respective spheres, that reserves of men, horses, and *matériel* come up from the rear in time, that unserviceable horses are removed out of the way, and they have specially to watch over the veterinary duties in the *depôts* for sick horses.

Such, in brief, is the organization of the Austrian Army, more especially as it would be developed in war time. I have now to point out the manner in which it is administered in peace time, and thence to show how the various arms of the service would be grouped into Field Units.

Austria-Hungary is divided into fifteen territorial districts called “General” and “Military Commands,” they are directly under the War Office, and are each commanded by a General Officer assisted by a

¹ See Table No. 6.

² See Table No. 7.

³ See Tables above mentioned in which details are given.

Staff and by District Intendance Authorities. These districts, which are nearly all contiguous with the political boundaries of Provinces, contain each of them a certain number of troops, recruiting and Landwehr districts, magazines, arsenals, &c., all of which are under the General commanding the whole territory.

The troops are divided in peace time into 32 infantry Divisions, with Commanders and staffs, composed of 2 to 3 infantry Brigades, and sometimes of a cavalry Brigade. In each territory there are a variable number of these Divisions. The artillery, engineers, pioneers, and train are not under the Divisional General, but are directly subordinate to the Territorial Commander through the chief of their own service upon his Staff. It is also to be observed that most of these units of the combatant branches, when quartered away from their regimental head-quarters, have with them all those stores which they would require for mobilization, thus greatly to facilitate that important operation.

The magazines of supply, clothing, &c., and the arsenals and laboratories for the manufacture and custody of warlike stores within the territory, are responsible to the General Commanding, for the efficiency of their charges, through the Intendance Authorities, and Artillery Chief respectively. These establishments expand in war time into field depôts, which are employed upon the lines of communications in a manner that will be related by-and-bye.

There is thus everything complete for the immediate mobilization of thirty-two Infantry Divisions, but nothing ready for the staffs of Army Corps, and these would have to be formed when hostilities break out; but it is further to be remarked that another infantry Division, and four cavalry Divisions, would be mobilized at the same time. The forces thus brought up to a war establishment would constitute the army of the first line; and the remainder, or that of the second line, would be formed by calling out the Landwehr. This briefly is organized as follows:—

1st. The Austrian Landwehr (excluding Hungary and the Tyrol) is composed of eighty infantry battalions and twenty-five cavalry squadrons, which would form two infantry Divisions and half a cavalry Division.

2nd. The Tyrolese Landwehr, or ten field and ten reserve battalions, and two squadrons of mounted men for orderly duty. They cannot, however, be used out of their own province without the sanction of the Diet at Innsbruck.

3rd. The Hungarian Landwehr includes ninety-two battalions 1st line, and 32 battalions 2nd line, and ten regiments of cavalry (four squadrons each), distributed into seven Honved Districts, and divided into Brigades (and Half-Brigades of three to four battalions each). These would form seven infantry Divisions and half a cavalry Division.

All these Landwehr troops can be expanded in an emergency by forming new units out of the depôts.

Thus, the whole armed strength of the Austro-Hungarian Empire is composed of forty-two Infantry and five Cavalry Divisions; of which thirty-three of the former and four of the latter make up the Active or

operating Army, while nine Infantry and one Cavalry Division constitute the Army of Reserve. These forces, however, do not include many others that would still be available for military purposes.

An Infantry Division is formed of—

12 battalions of infantry of the line.

2 „ rifles (or infantry employed independently).

3 or 4 squadrons of cavalry (taken from the Army Corps cavalry Brigade).

1 division of batteries.

1 company of engineers.

The total combatant effective of this unit amounts to—

13,093 infantry	} 13,698 men.
605 cavalry	
24 guns.	

But, by adding in the non-combatants, *i.e.*, servants, dismounted men, medical staff, carriers for wounded, regimental transport, military train, ammunition columns, civilians &c., we get a total *personnel* of 16,663 men.

A Cavalry Division is formed of—

2 or more cavalry Brigades of two regiments each, or 24 field squadrons. And—

1 division of horse artillery.

In combatant effectives it amounts to—

3,640 cavalry.
12 guns.

and, reckoning non-combatants, to 5,386 men.

An Army Corps is composed of—

3 Infantry Divisions.

1 cavalry Brigade distributed among the infantry Divisions.

2 divisions of batteries.

1 company of pioneers.

Fighting effective—

39,498 infantry	} 41,313 men.
1,815 cavalry	
112 guns.	

Including non-combatants, 52,405 men.

I now come to the organization of the lines of communications in the field.

A Division is the smallest grand tactical and administrative unit; and it is so constituted that it can sustain by itself a struggle with the enemy for a certain period. At the same time it is small enough to enable the General in command personally to direct the details of everything placed under his orders. Divisions should thus include all three arms of the service, and have near them reserves of ammunition sufficient for one day's action at least, and supplies for six or eight days, as well as the necessary means of providing for the sick and wounded. The Brigades in Austria are not permanently established; their constitution is mentioned in the *Ordre de Bataille* published on the eve of a war, and normally two go to a Division; but the tactical grouping of the troops during hostilities depends upon the

arrangements of the Divisional General, which may be temporary or otherwise.

As very many independent Divisions under the General of an Army would lead to confusion, the Austrians group them by threes into Army Corps, and this unit has also a certain quantity of reserve ammunition and supplies, *not* for the Divisional troops, but for those which belong exclusively to the Army Corps. This unit also has a field chest containing the treasury for all the troops belonging to it.

The "Army," which is the smallest strategical unit, is formed of several Divisions or Army Corps, together with a certain quantity of technical troops, and contains in its rear all those reserves and magazines for the supply of everything that may be required for those forces which constitute it.

Lastly, when several "Armies" operate together, they are placed under the command of the General-in-Chief, who directs the operations, but who is not provided with any *impedimenta*, except the one squadron of train to supply the grand head-quarters and the troops which directly belong to it.

Thus, we see that in Austria the Division and Army Corps are administratively upon the same approximate level; that both are subordinate to the "Army;" that to each of the latter a line of communications is assigned, upon which to store the reserves which are necessary to the troops; and finally that the Commander-in-Chief has only to divide off the country behind the operating forces for the use of the various "Armies," but that he has nothing to say to the details of administration.

The reserve ammunition, supplies, sanitary establishments, magazines, &c., belonging to the units that are above mentioned, are technically called "Reserve Establishments;" and in accordance with what has just been said, they are divided into two lines. The 1st line reserve establishments are those which are assigned to the troops immediately under the Divisional, Army Corps, and Army Generals, and are directly subordinate to the latter: the 2nd line reserve establishments are divided into so many groups, and are placed in rear of an "Army," under a General Officer who commands the lines of communications.

The "1st Line Reserve Establishments"¹ include—

1st. Artillery reserve establishments; or—

(a.) Divisional ammunition parks,² formed from the ammunition columns raised by the divisions of batteries, and containing 30 rounds per rifle and 82 rounds per gun.

(b.) Army Corps ammunition parks, also formed from the ammunition columns, and containing 27 rounds per cavalry firearm, 20 per man for the technical troops, and 82 rounds per gun for the Corps artillery.

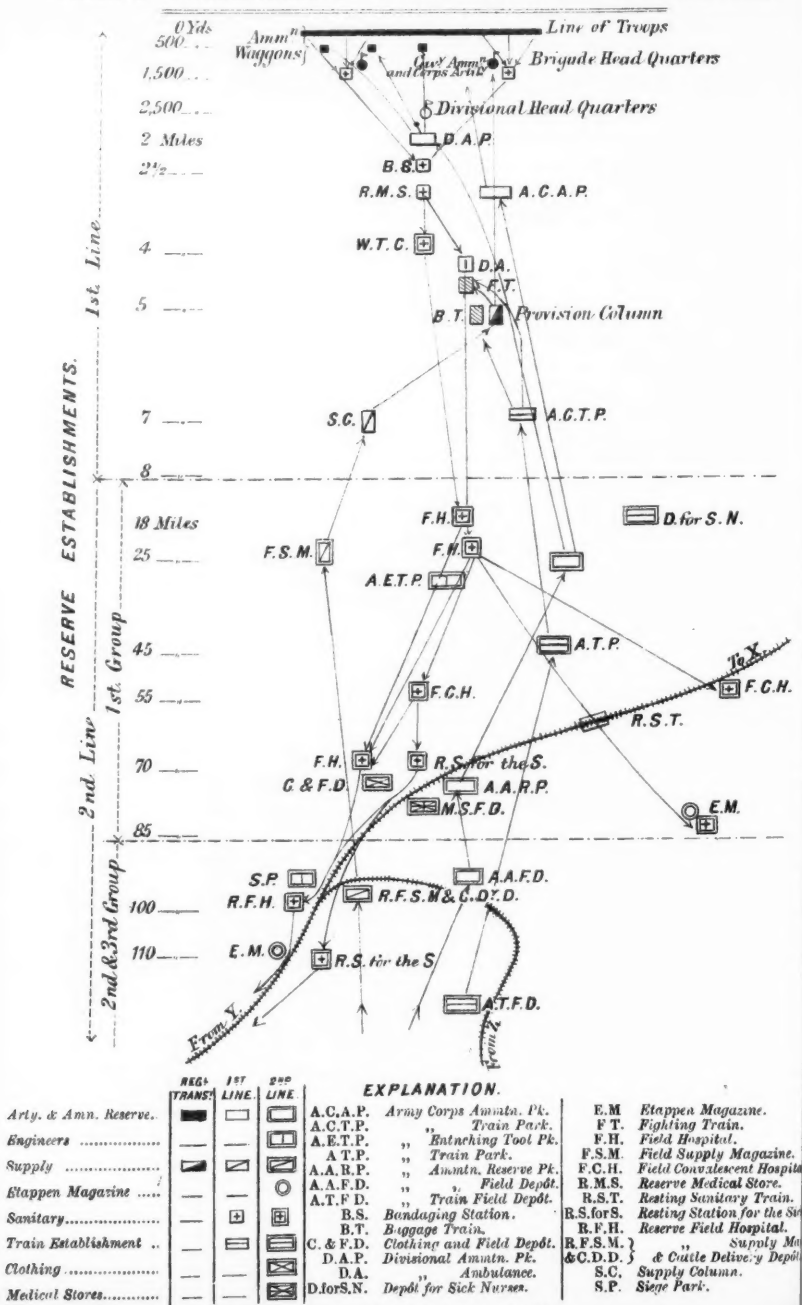
2nd. Field Supply Establishments; or—

(a.) Provision columns, part of the Baggage Train which belongs to

¹ See Plate.

² Only one wagon for a cavalry Division; but if acting independently, it gets a column provided from the Army Ammunition Park.

DIAGRAM SHEWING THE APPROXIMATE POSITION OF THE
RESERVE ESTABLISHMENTS &c OF AN AUSTRIAN ARMY IN THE FIELD.



the regimental transport, and which may be separated from the troops, carrying two days' rations, and three days' meat rations.

(b.) Supply columns carrying four days' rations.¹

3rd. Sanitary Establishments; these only belong to Divisions,² and are composed of—

(a.) Two stations for immediate surgical aid.

(b.) One bandaging station.

(c.) An ambulance station, sufficient for fifty severely wounded men; they can assist in the care of the sick at the bandaging stations, or else they serve to connect the latter with the field hospitals.

(d.) Reserves of medical stores.

These establishments are assisted by the Field Sanitary Columns of the Teutonic Order.

4th. Train Parks, belonging to the Army Corps; their functions have already been alluded to.

The "2nd Line Reserve Establishments"³ include:—

1st. Artillery Reserve Establishments.

(a.) 1st group: the "Army" Ammunition Park formed by two ammunition columns from each artillery regiment in the "Army," and containing 8 rounds per rifle and 30 rounds per gun for troops in Army Corps and Infantry Divisions; also 8 per carbine and revolver, 100 rounds per gun and 20 per rifle for the technical troops and for independent cavalry Divisions.

(b.) 2nd group: the Army Ammunition Reserve Park; the stores are usually collected and kept ready on wagons, which, however, are not horsed. This contains 30 rounds per rifle, 8 per carbine or revolver, and 36 per gun.

(c.) 3rd group: the Army Ammunition Field Depot, which is generally formed where roads or railways branch off in different directions, and it contains 60 rounds per rifle, 12 for the cavalry, and 130 to 150 per gun.

All these Parks are furnished with their stores from the permanent arsenals nearest the seat of war, and are provided with a certain quantity of technical artillery *personnel* who can repair arms which may have become damaged, or supply others to replace them. They have also to push to the front reserves of men and horses.

2nd. Engineer Reserve Establishment.

(a.) Entrenching tool columns, for constructing more important field works, for the preliminary operations against a fortress, and for replacing Linnemann's infantry spades, when lost or damaged. Each column has seven two-horsed wagons, and all the transport required is furnished by the Engineers. There are usually as many columns as there are Army Corps, and they can be attached to them, or else to Divisions, if necessary.

(b.) Engineers' siege park; only formed when a fortress has to be besieged or if large works have to be constructed. This park is formed by mobilizing a portion of the great Engineer Park at Vienna.

¹ See Tables Nos. 2 to 6 inclusive.

² In the cavalry Divisions these establishments are smaller.

³ See Plate.

Both these establishments are replenished from Vienna, or from others that might be formed in fortresses near the seat of war.

3rd. Field Supply Establishments.

(a.) 1st group. Field Supply Magazines. These are formed upon the lines of communications from the permanent military supply establishments, which are scattered over the Empire. They have to feed the Supply Columns with provisions, when the latter have been consumed in the first line; and their general capability is to contain six days' rations for 50,000 men and 10,000 horses. Transport is furnished by a civilian train, conducted by a section of Military Train,¹ and escorted by a guard; the stores are either entirely or partly packed upon wagons, and are generally two days' march from the front. These magazines also, which contain 80 field ovens each, are usually attached one to every Army Corps; and they may draw their supplies by requisition from the country in which the troops are operating.

(b.) 2nd group, also formed on mobilization from the permanent establishments, include—

(i.) Reserve Supply Magazines, usually one to every two army corps, to feed the field magazines.

(ii.) Reserve Bakeries, containing, when complete, 64 bakehouses, sufficient to produce 116,800 rations of bread every 24 hours. As a rule there is one of these establishments to two Army Corps.

(iii.) Cattle Delivery Depôts for collecting cattle; one depôt to every "Army."

(iv.) *Etappen* magazines for the purpose of supplying those men employed upon the lines of communications.

(v.) March magazines to supply troops upon the march; and they may also be established during a concentration of the army, to provide for the different units proceeding to the place of rendezvous.

4th. Sanitary Establishments.

(a.) 1st group include—

(i.) Field Hospitals, including also those of the "Teutonic Order." The latter are attached to Armies and have their own *personnel* and carriages. The field hospitals contain each of them accommodation for 500 or 600 patients,² and they are calculated at three per Army Corps, giving room for some 1,700 sick; they have also to renew the medical stores in the Divisional establishments. The hospitals belonging to the Teutonic Order are often placed just in advance of the others, being more mobile, and better adapted for men severely wounded.

(ii.) Field convalescent Hospitals receive men prostrate by fatigue, or those nearly cured in the field hospitals; each should be able to hold 500 patients, and there should be one per Army Corps.

¹ See Table No. 8.

² The Field Hospitals are either "Divisible" or "Indivisible;" the former can accommodate 600 patients, and are formed into three sections, each for 200 sick—these are placed in front. The latter contain 500 patients, and are usually in rear. An Army Corps has normally allotted to it, two "Divisible" and one "Indivisible" Field Hospital.

(b.) 2nd group include—

(i.) Reserve Hospitals, contain men from the field hospitals, whose cases delay the mobility of the latter. There should be three per "Army," each to contain 200 patients.

(ii.) Resting Stations for the Sick, are formed to afford short rests, food, and medical aid to the sick on their way to the rear. The "Army" should have two such stations, each sufficient for 200 men.

(iii.) Railway Sanitary Trains are bodies with a fixed *personnel* and with the necessary medical stores to transport the sick and wounded not only from the 2nd line sanitary establishments, but also from the Divisional ambulances. At large railway stations, or where Sanitary Trains are formed, there are committees to superintend the removal of the sick and wounded.

(iv.) Wounded Transport Columns are attached to field hospitals nearest to the front, for the purpose of conveying the wounded from Divisional sanitary establishments to the field hospitals, or from the latter to the railway stations, where Sanitary Trains are prepared. They are often formed by voluntary assistance, but must be constituted into regular bodies, and they may help to carry the wounded from the battle-field.

5th. Field dépôts for clothing and sanitary *matériel*.

Usually there is one such dépôt per Army, but in cases of necessity, one or more branches may be formed. It contains stores of clothing, equipment, saddlery, and sanitary *matériel* for the troops or for the reserve establishments belonging to the Army; also such as would be required if other sanitary establishments had to be formed on the lines of communications. The dépôt should contain sufficient stores for two or three weeks, and be in easy communication with the permanent establishments.

6th. Field dépôts for medical stores.

This is formed to supply medical comforts and stores to the 1st and 2nd line reserve establishments. Each Army should have one; and generally it is placed near the clothing and sanitary *matériel* dépôt.

7th. Military Train and Dépôts for sick horses.

(a.) 1st group include—

(i.) Dépôts for sick horses; generally one per Army Corps.

(ii.) The Army Train Parks (already alluded to).

(b.) 3rd group.—The Army Field Train Dépôt formed from the Transport *Matériel* Department, and has already been alluded to.

Besides the above, which are the *mobile* magazines and dépôts, upon the lines in rear of the army, the arsenals, the supply, the clothing, the military medical, and the transport *matériel* permanent magazines which are at Vienna, or which lie nearest to the theatre of war, are mobilized and constitute the Grand Dépôts, whence ammunition, arms, stores, equipment, clothing, &c., are drawn for the army. The permanent hospitals and convalescent houses, whether military or not, are, moreover, brought into requisition for the treatment of the sick and wounded.

Such are the establishments in rear of an Austrian Army in the

Field. Now it has been already remarked that the first line reserves are under the orders of the Commanders of those field units to which they belong; in the second line, although belonging to the "Army," it is different. At the head of the latter, there is a General in command, and another as Chief of the Staff. The "Army Command" is, however, divided into two, viz.: the "Army head-quarters," which directs the active operations in the field, and the "Army General Command," headed by a General of high rank upon the lines of communications. The latter is assisted by a Chief of the Staff, a military section and an administrative section, and he has under him a certain number of reserve men to fill up vacancies as they occur in the front as well as troops to protect the *etappen* lines.

The Military Section directs the transport of men, horses, and wagons to the front and to the rear, the formation, the movement, and the employment of the second line reserves, and regulates the lines of communication, in accordance with the operations in front.

The Administrative Section has to furnish and distribute money to the military chests, to collect and provide provisions and stores for the great magazines, to superintend the supply to the front, and to control the accounts within the region of the Army General Command.

The relationships between the General Officer Commanding the "Army" and the Army General Commander are as follows: the latter is subordinate to the former, in matters which affect the troops directly, thus, as to the position, &c., of the reserve establishments, but he is independent, and directs those things for which he alone is responsible, such as the collection of supplies and the service on the lines of communications; he is also the controlling organ of the War Ministry. Further, as it is necessary that he should have frequent interviews with the "Army" General, when their head-quarters are separated, another General Officer is appointed to act as his assistant, and to take his place when he is absent.

The Chief of the Staff of the "Army" is considered the first assistant of the General Commanding; he is supreme, and gives instructions (even to the Army General Command) in all matters relating to the operations of the Army, otherwise he heads his own section, viz., the General Staff of the "Army" Commander. In the same way also the Chief of the Staff of the "Army General Command" has control over the administrative section in matters relating to the operations of the forces, but otherwise he heads the military section alone. This I may say is the general rule which regulates the Chiefs of the Staffs of Army Corps and of Divisions also.

The Commander-in-Chief assigns to each "Army" the zone of country which shall be under it; and the limits of this are determined by the localities from whence the lines of communication commence, and by the railway stations from whence the lines of rail are under the Director of Field Railways. If the war is conducted within the frontiers of the Empire, every permanent military authority, garrison, dépôt, all reserve troops, whether Landwehr or not, &c., are under the Commander of the Army through the Army General Command; within this region also the civil administration may be partially or

wholly suspended. If hostilities take place in an enemy's country, the Army General Commander is charged with the administration of the occupied territory, and he may, when so ordered by the Emperor, establish "Civil and Military Governments."

The general duty of the Officer commanding the lines of communications, or the object of the *etappen* services which he directs, is to preserve the army in the field in a fit state to push forward its operations, to secure its rear and to draw from the country the resources which it contains. The regulation of the lines of supply; the establishment of a Base (*Etappen Anfangs Orte*) on the confines of the district already defined, of chief *etappen* points where men and stores are collected to be dispatched to the various corps, and of the terminal stations up to which railways can be used, fall within these duties. Where railways do not exist, the train in the *etappen* district is formed by civilian vehicles and horses, but these must be conducted by regular train sections when possible, or otherwise by *etappen* troops.

To superintend and carry out these duties, there is the first Army General Command as chief authority; *Etappen* Inspections, one on each line to superintend the duties upon it; *Etappen* Commandants and Committees, placed at important stations or junctions to regulate the traffic of the lines, and to utilize the resources of the country near them. Under these there are a certain number of troops and police to protect the rear of the army from attacks, and to preserve order.

One word on the Intendance; this branch, which directs and controls the administrative services of the army, exercises a considerable independence in peace time, being responsible in a great measure to the Economic Section of the War Ministry alone. In war time the principle is changed, and the Intendants are then responsible to the Generals on whose staffs they are placed (except as far as regards finance), and the decision of the latter must be carried out, even should it differ from the opinion of the Intendant, who in such cases can only record his opinion; the duties of the Intendance at that time are to obtain at the right time, and in sufficient quantities, all that which is required by the troops, to supply them with provisions, forage, clothing, equipment, and money, and to ensure that these are distributed at the proper moment. Intendance officials are placed upon the staffs of the General-in-Chief, of Commanders of "Armies," of Army Corps, and of Divisions. Also a General Intendant, junior to, but of the same rank as the official with the General-in-Chief, directs the Administrative Section of the Army General Command. These officials are almost independent of each other, within their own respective spheres, and are directly responsible for their own acts. As regards the relations between the General Staff and the Intendance, the regulations prescribe that the duties should be carried out so as to ensure mutual support and to prevent friction, but the Intendant must always ask for instructions from the Chief of the Staff, before taking any steps which affect military operations, and inform him of all important orders which relate to his department before they are submitted to the General; and, on the other hand, the Chief of the Staff communicates to the Intendant all projected operations if they should require his co-operation.

This in brief is the organization of the Austrian lines of communications; and it is to be observed that not only are these regulations applicable to large wars in which the greater part of the forces of the Empire would be employed in several "Armies" under a Commander-in-Chief, but also to smaller wars in which, perhaps, only a few Divisions might be employed. Independent Army Corps and Divisions in such cases would have allotted to them a certain number of second line reserve establishments according to requirement, but still following the regulations as above described. Further, when such a body of troops is employed by itself upon a distinct line of communications, it has an "*Etappen* Direction" which is similar in composition to an Army General Command, and which is adapted to the magnitude of the operations.

Before finishing this paper, I must also remark upon the care which has been taken to provide a complete organization for mountain warfare. Austria borders on the Alps, and on the hilly spurs of the Balkans, and there is every necessity that she should have some system in thorough order to be able to operate in those districts. Not only, therefore, are mountain batteries and mountain train squadrons arranged, but an organization has been completed—although as yet a great deal is incomplete—for Divisions and Brigades, for the carriage of their ammunition, baggage, sanitary establishments, and supplies. In this case it is natural, where small columns may become separated, to divide the fighting unit in such a manner as will enable them to hold their own against the enemy. For this reason the Brigade is the smallest fighting and administrative unit, and three of these constitute a Mountain Division. It will be observed the Austrian system is in this respect somewhat similar to our own, viz., that three units are grouped into the higher unit; and this seems to be preferable to the German plan, by which two Divisions alone form an Army Corps; first because you always have two in the first line and one as a reserve, and, secondly, because there is a greater economy in Staffs, for a General can command three units quite as easily as two.

In now closing my lecture I would ask your permission to recapitulate the points which seem to me to be of special interest.

1st. The equipment of the troops, the infantry spade, and the ammunition expense pouch.

2nd. The plan adopted by which the troops are not weakened to supply servants, orderlies, &c., to Officers or to the different headquarters.

3rd. The system by which Divisions can be quickly and easily mobilized with staffs complete, and composed of men who have been accustomed to work together; and—

4th. And finally, the general organization of the Train, and the lines of communication, not only for large armies, but for smaller expeditions and for mountain warfare.

I am aware that much has been neglected in this paper; but it is impossible to compress everything into one lecture, and I fear that I have already made this one too long. I will, therefore, now conclude, hoping that I may have given a rough sketch of a subject which will be interesting to some of the members of this Institution.

TABLE No. 1.—Showing War Strength of an Infantry Regiment and Battalion of Rifles.

Infantry of the Line.	Rifles.	Belonging to Corps.	Officers.		N.C.O.'s and Men.			Civilians, &c.		Horses.		Wagons.		Establishment drawing Rations			Fighting Strength.
			Paymasters.	Surgeons.	Combatant.		Non Combatant.	Civilians, &c.	Riding.	Draught and Reserve.	Ammunition (4-horsed)	Small Train.		Officers.	Non-commissioned Officers and Men.	Horses.	
					With Rifles.	Without Rifles.						Fighting.	Baggage.				
Staff of a Field Infantry Regt.	..	3	1	6	7 ^a	..	75 ^c	8	16	17	..	2	10	90	33	2	
" Reserve "	..	3	1	4	5 ^a	..	20 ^c	7	10	12	..	1	8	32	12	2	
A Company	215 ^a	9 ^b	8 ^c	4	7	20	2	..	4	232	1	224	
A Battalion in a Regt. <i>f</i>	..	18	..	..	860	38 ^b	46 ^c	4	7	20	2	5	18	948	27	916
A Field Regt. (3 Battalions) <i>..</i>	..	57	1	6	2,587	114	213	20	37	77	9	5	64	2,384	114	2,750	
A Reserve " (2 " <i>..</i>)	..	39	1	1	1,725	76	112	15	27	52	4	..	11	1,834	79	1,834	
A Depot Battalion (mobilized)	..	23	1	1	1,075	20	38	2	4	..	..	..	25	1,135	4	1,117
A Rifle Company	4	..	..	219	9	8	1	..	..	..	..	4	236	1	228	
" Battalion	19	1	2	878	37	57	7	13	27	2	6	22	979	40	981	
" Depot Co. (mobilized)	..	4	..	1	219	4	5	..	..	..	..	..	5	228	..	227

a. On the Staff of a Field or Reserve Regiment, this includes Military Police and carriers for the wounded (Non-commissioned officers).

In the Company two men are shoemakers, and act as baggage guard.

b. Four cadets (1 per company), sixteen pioneers (four per company) and eighteen buglers, &c. (four per company).

c. On the Staff of a Field Regiment includes : band, drivers, servants, bandage carriers, &c. ; of a Reserve Regiment, bandage carriers, &c. ; in a Battalion, includes armoured, pay sergeants, carriers for wounded, drivers, servants.

d. Båtmen, drivers for market carts, men to look after the same, butchers.

e. Includes horses the property of Officers.

f. An independent Battalion of the line has a fighting strength equal to one in a regiment, but an establishment of non-combatants, horses, and wagons nearly equal to a rifle battalion.

TABLE No. 2.—Showing War Strength of a Squadron of Military Train belonging to an Infantry Division.

	Personnel.		Horses.		Wagons.		Civilian Train.			
	Officers.	N.C.O.'s and men.	Riding.	Draught.	2 horsed. ^d	4 horsed. ^e	Drivers.	Harnessed Horses.	Carriages.	Wagons.
Squadron Staff	2 ^a	26 ^b	4	8	..	2	..	..	..	..
1st. Section.										
Sectional Staff	1	11 ^b	2	6 ^c	..	1	..	..	..	..
Infantry Divisional Staff. . . . .	..	8	1	14	3	2	..	..	..	..
Two Brigade Staffs ..	..	2	..	4	2	..	..	..	..	..
Divisional Sanitary Establishment ..	..	39	10	56	14	7	..	..	..	..
Sanitary Column of the Teutonic Order. .	..	9	..	14	4	1	..	..	..	..
Field Post .. ..	..	5	1	6	1	1	..	..	..	..
Carriages for Officials, &c. ^f .. ..	..	..	..	..	..	..	3	6	3	..
Infantry at Headquarters .. ..	..	1	..	2	1	..	..	..	..	..
Total 1st Section ..	1	75	14	102	25	12	3	6	3	..
2nd Section.										
Sectional Staff ..	1	14 ^b	1	8 ^c	..	..	..	..	..	..
Supply Column ..	..	98	9	168	..	42	24	48	1	23
Total 2nd Section ..	1	112	10	176	..	42	24	48	1	23
3rd Section.										
Sectional Staff ..	1	14 ^b	1	8 ^c	..	..	..	..	..	..
Supply Column ..	..	98	9	168	..	42	24	48	1	23
Total 3rd Section ..	1	112	10	176	..	42	24	48	1	23
Total Squadron ..	5	325	38	462	25	98	51	102	5	46

a. Includes one Veterinary Surgeon.

b. Includes a pay sergeant, a trumpeter, Officers' servants, artificers, and reserve men.

c. Includes reserve horses.

d. Includes light wagons, ambulance wagons, field post cart.

e. Includes heavy wagons, those carrying medical stores, &c., large wagon in which post office is contained.

f. Includes Chaplains, Judge Advocates, Officials (Intendants, &c.).

TABLE No. 3.—Showing War Establishment of a Squadron of Military Train belonging to a Cavalry Division.

		Personnel		Horses.		Wagons.		Civilian Train.			
		Officers.	N.C.O.'s and men.	Riding.	Draught.	2-horsed <i>d</i>	4-horsed <i>e</i>	Drivers.	Harnessed horses.	Carriages.	Wagons.
Squadron Staff		3 ^a	27 ^b	4	8	..	2	..	..	..	..
1st Section.	Sectional Staff	1	13 ^b	2	9 ^c	..	1	..	..	..	..
	Cavalry Divisional Staff ..	..	8	1	14	3	2	..	..	..	..
	Two Brigade Staffs .. ..	..	2	..	4	2	..	..	..	..	..
	Divisional Sanitary .. ..	..	9	1	14	5	1	..	..	..	..
	Field Post (Carriage) .. ..	..	5	1	6	1	1	..	..	..	..
	Carriages for Officials ^f ..	..	..	..	..	..	..	2	4	2	..
Total 1st Section		1	37	5	47	11	5	2	4	2	..
2nd Section.	Sectional Staff	1	14 ^b	1	8 ^c	..	..	..	..	..	..
	Supply Column .. ..	..	101	11	168	..	42	48	96	1	47
	Total 2nd Section	1	115	12	176	..	42	48	96	1	47
3rd Section.	Sectional Staff	1	14 ^b	1	8 ^c	..	..	..	..	..	..
	Supply Column .. ..	..	101	11	168	..	42	48	96	1	47
	Total 3rd Section	1	115	12	176	..	42	48	96	1	47
Total Squadron		6	294	33	407	11	91	98	196	4	94

a. Includes a Surgeon and a Veterinary Surgeon.*b.* As in Table No. 2.*c.* Ditto.*d.* Ditto.*e.* Ditto.*f.* Ditto.

TABLE NO. 4.—Showing War Strength of a Squadron of Military Train belonging to an Army Corps.

				Personnel		Horses.		Wagons.		Civilian Train.			
				Officers.	N.C.O.'s and Men.	Riding.	Draught.	2-horsed. ^d	4-horsed. ^e	Drivers.	Harnessed Horses.	Carriages.	Wagons.
Squadron Staff				3 ^a	21 ^b	4	4	..	1	..	..	..	..
1st Section.	Fd. Tele. Sect.	2nd Ln.	Sectional Staff	1	8 ^b	2	2 ^c	..	..	..	..	..	..
			Military Chest and Office .. .. .	..	20	2	36	4	7	..	..	..	..
			Cavalry Brigade Staff .. .. .	..	1	..	2	1	..	..	..	..	..
			Field Post Direction .. .. .	..	4	1	4	..	1	1	2	1	..
			1st Ln. } Head-quarters Army Corps. . . . .	..	12	1	21 ^c	2	4	..	..	..	..
				..	12	1	21 ^c	2	4	..	..	..	..
			2nd Ln. } Head-quarters "Army General Command" .. .. .	..	13	1	22	3	4	..	..	..	..
				..	4	..	8	..	2	..	..	..	..
			Field "Transport Hans" .. .. .	..	..	..	..	..	3	6	3	..	..
			Carriages for Officials <i>f.</i> .. .. .	..	..	..	..	..	..	..	..	..	..
Infantry at Head-quarters .. .. .			..	1	..	2	1	..	..	..	..	..
Total 1st Section				1	75	8	118	13	22	4	8	4	..
2nd Section.			Sectional Staff	1	13 ^b	1	10 ^c	..	1	..	..	..	..
			Supply Column .. .. .	..	56	7	88	..	22	55	110	1	54
			Total 2nd Section	1	69	8	98	..	23	55	110	1	54
Total Squadron				5	165	20	220	13	46	59	118	5	54

a. As in Table No. 3.*b.* As in Table No. 2.*c.* Ditto.*d.* Light wagons; telegraph wagons (offices and instruments, &c.).*e.* Heavy wagons; those for the telegraph lines; for the post; and special wagons for the Field "Transport Haus."*f.* For paymasters and officials.

TABLE NO. 5.—Showing War Establishment of Squadron of Military Train of an "Army," and an "Army General Command."

	Personnel.		Horses.		Wagons.		Civilian Train.			
	Officers.	N.C.O.'s and Men.	Riding.	Draught.	2 horsed ^d	4 horsed ^e	Drivers.	Harnessed Horses.	Carriages.	Wagons.
Squadron Staff	4 ^a	29 ^b	5	4	..	1	..	..	..	..
1st Section.										
Sectional Staff ..	1	13 ^b	2	6 ^c	..	1	..	..	..	..
Military Chest, Office, and Sanitary Fourgon	} ..	27	3	46	11	6	..	..	..	..
Field Post (Carriage)		5	1	6	1	1	..	..	..	..
Field Telegraph Direction, 1st line ..	..	1	..	2	1	..	1	2	1	..
Carriages for Officials &c. f. ..	..	..	..	..	..	..	2	4	2	..
Infantry at Headquarters .. ..	..	3	..	6	1	1	..	..	..	..
Total 1st Section ..	1	49	6	66	14	9	3	6	3	..
2nd Section.										
Sectional Staff ..	1	21 ^b	4	6 ^c	..	1	..	..	..	..
Military Chest and Office .. ..	..	29	3	48	8	8	..	..	..	..
Field Post Direction	..	4	1	4	..	1	1	2	1	..
Field Post (Carriage) .. ..	..	5	1	6	1	1	..	..	..	..
Field Telegraph Direction, 2nd line ..	..	..	..	..	..	..	1	2	1	..
Field "Transport Haus" .. ..	..	4	..	8	..	2	..	..	..	..
Carriages for Officials/	..	1	..	..	..	..	8	16	8	..
Infantry at Headquarters .. ..	..	3	..	6	1	1	..	..	..	..
Total 2nd Section ..	1	67	9	78	10	14	10	20	10	..

a. As in Table No. 3.

b. As in Table No. 2.

c. Ditto.

d. Includes light wagons, sanitary fourgon, post carts, field printing presses, telegraph wagon.

e. Includes heavy wagons; those for the post; and for the Field "Transport Haus."

f. Includes Chaplains, Judge Advocates, Surgeons, Paymasters, and Officials.

TABLE NO. 5—*continued.*

		Personnel.		Horses.		Wagons.		Civilian Train.		
		Officers.	N.C.O.'s and Men.	Riding.	Draught.	2 horsed ^d	4 horsed ^e	Drivers.	Harnessed Horses.	Carrriages. Wagons.
3rd Section.	Sectional Staff ..	1	18 ^b	1	10 ^c	..	1	..	..	..
	Supply Column ..	..	75	7	128	..	32	23	46	1 22
	Total 3rd Section ..	1	93	8	138	..	33	23	46	1 22
4th Section.	Sectional Staff ..	1	18 ^b	1	10 ^c	..	1	..	..	..
	Supply Column ..	..	75	7	128	..	32	23	46	1 22
	Total 4th Section ..	1	93	8	138	..	33	23	46	1 22
Total Squadron ..		9	331	36	424	24	90	59	118	15 44

Sections 1, 3, and 4 belong to the "Army;" No. 2 Section to the Army General Command.

b. As in Table No. 2.

c. Ditto.

d. Includes light wagons, sanitary fourgon, post carts, field printing presses, telegraph wagon.

e. Includes heavy wagons; those for the post; and for the Field "Transport Haus."

TABLE No. 6.—Showing War Establishment of a Squadron of Military Train belonging to the Head-Quarters of the Commander-in-Chief.

			Personnel		Horses.		Wagons.		Civilian Train.			
			Officers.	N.C.O.'s and Men.	Riding.	Draught.	2-horsed <i>d</i>	4-horsed <i>e</i>	Drivers.	Harnessed Horses.	Carriages.	Wagons.
Squadron Staff			4 <i>a</i>	21 <i>b</i>	5	4	..	1	..	..	..	..
1st Section.	Sectional Staff	1	12 <i>b</i>	2	6 <i>c</i>	..	1	..	..	..	..	..
	Military Chest and Office ..	..	14	2	22	7	2	..	..	..	..	..
	Sanitary Fourgon .. .. .	..	1	..	2	1	..	..	..	..	..	..
	Provision Column .. .. .	..	14	1	24	..	6	..	..	..	..	..
	General Direction of Field Posts ..	..	4	1	4	..	1	1	2	1	..	..
	Field Post (Carriage) .. ..	..	5	1	6	1	1	..	..	..	..	..
	General Direction Field Telegraph ..	..	..	..	..	..	..	1	2	1	..	..
	Field Telegraph Section, 1st line ..	..	6	1	8	2	1	..	..	..	..	..
	Carriages for Officials <i>f</i> ..	..	1	..	..	..	..	7	14	7	..	..
	Infantry at Head-quarters ..	..	1	..	2	1	..	..	..	..	..	..
Total 1st Section			1	58	8	74	12	12	9	18	9	..
2nd Section.	Sectional Staff	1	11 <i>b</i>	1	8 <i>c</i>	..	1	..	..	..	..	..
	Supply Column .. .. .	..	34	4	56	..	14	10	20	1	9	..
	Total 2nd Section	1	45	5	64	..	15	10	20	1	9	..
Total Squadron			6	124	18	142	12	28	19	38	10	9

a. As in Table No. 3.*b.* As in Table No. 2.*c.* Ditto.*d.* Light wagons, sanitary fourgon; field telegraph stations; post cart.*e.* Heavy wagons; one for telegraph wire; those for the post; field rapid printing press wagon.*f.* As in Table No. 5.

TABLE NO. 7.—Showing War Establishment of—(1) a Squadron of Military Train to horse and drive four Bridge Trains; (2) an Army Corps Train Park; and (3) an Army Train Park.

(1.) SQUADRON TO HORSE AND DRIVE FOUR BRIDGE TRAINS.

				Personnel.		Horses.		Wagons.
				Officers.	N.C.O.'s. and Men	Riding.	Draught.	4-horsed.
Squadron Staff				3 <i>a</i>	20 <i>b</i>	2	4	1
1st Section.	Sectional Staff			1	15 <i>b</i>	2	14 <i>c</i>	1
	Bridge Train .. ..			..	45	6	72	4
	Total Section			1	60	8	86	5
Four Sections.	The other three sections are like No. 1 section.							
	Total Squadron			7	260	34	348	21
	Squadron with pioneer <i>material</i> <i>dépôt d.</i>			7	272	35	368	26

(2.) AN ARMY CORPS TRAIN PARK.

Park Staff				3 <i>a</i>	26 <i>b</i>	4	4	1 <i>f</i>
1st Park Column.	1st column			1	26 <i>b</i>	3	24	6 <i>f</i>
	Reserves <i>e.</i> .. ..			..	42	3	34	..
	Total 1st column			1	68	6	58	6
Three Park Columns.	The other two Park columns are like No. 1.							
	Total Army Corps Train Park			6	220	22	178	19

a. As in Table No. 3. In the Army Train Park also a Paymaster.

b. As in Table No. 2.

c. Ditto.

d. Squadrons Nos. 66, 68, 70, 72, 74, and 75 have alone this extra establishment.

e. In the Army Corps and Army Train Parks, to be sent to the front as may be required.

f. In the Army Corps and Army Train Parks, heavy wagons, with baggage, supplies, forges, tools, harness, wheels, &c.

TABLE NO. 7—*continued.*

				Personnel.		Horses.		Wagons.
				Officers.	N.C.O.'s and Men.	Riding.	Draught.	4-horsed.
(3.) AN ARMY TRAIN PARK.								
Park Staff				5 ^a	26 ^b	4	4	1 ^f
1st Park Column.	1st column			1	26 ^b	3	24	6 ^f
	Reserves ^e .. .. .			..	73	13	60	..
	Total 1st column			1	99	16	84	6
Two Regiments of Train (1st and 3rd) form four Park columns ; the 2nd Regiment forms five.								
Total Army Train Park (1st or 3rd Regiment) }				9	422	68	340	25
Total ditto (2nd Regiment) ..				10	521	84	424	31

a. As in Table No. 3. In the Army Train Park also a Paymaster.

b. As in Table No. 2.

e. In the Army Corps and Army Train Parks, to be sent to the front as may be required.

f. In the Army Corps and Army Train Parks, heavy wagons, with baggage, supplies, forges, tools, harness, wheels, &c.

TABLE No. 8.—Showing War Establishment of a Section of Military Train belonging to a Field Supply Magazine.

	Military Portion.				Civilian Train.						
	Personnel.		Riding Horses.	Wagons, 4-horsed.	Personnel		Horses.		Vehicles, 2-horsed.		
	Officers.	N.C.O.'s and Men.			Conductors.	Drivers.	Riding.	Draught.	Carriages.	Baggage.	Wagons.
Detachment of Train	1	4 <i>b</i>	2	..	..	3	..	6	2	1	..
Three Train Columns {	One Column	3 <i>a</i> 43 <i>b</i>	20	..	6	546	6	1,092	1	4	541
	Total 3 Columns	9 129	60	..	18	1,638	18	3,276	3	12	1,623
Detachment for Field Bakery .. }	..	13 <i>b</i>	5	40 <i>d</i>	4	202	4	^c 404	4	4	110
Detachment for Cattle Depôt .. }	..	..	..	1	..	25	..	50	3	3	17
Total Section of Military Train .. }	10	146	67	41	22	1,868	22	3,736	12	20	1,750

a. Includes a Veterinary Surgeon.*b.* Includes a pay sergeant per column, Officers' servants, and artificers.*c.* Includes reserve horses.*d.* For Field ovens ; each contains two.

LORD WAVENEY: I was most unfortunate in not being able to be present until quite the close of what is evidently a most interesting lecture, and in so saying I may be chargeable with presumption in rising to make any remarks upon it; but I observe that for the moment the place is vacant, and the points on which I mean to remark are three with which we are sufficiently familiar in the consideration of intrenchments and of armies; so that possibly I may be permitted to occupy a few moments of your time. There is a point to which I observe our gallant lecturer attaches considerable importance, and that is the provision for halting ground in the field by means of a portable infantry spade. Of late years that system has attracted considerable attention. I believe the first idea was sketched out by the shelter trenches of which we saw a good many in the early manoeuvres of our troops at home, and which have been subsequently carried on to a very great extent, but by no armies more than by the Northern and Southern armies engaged in the great American struggle. In all the movements of these great armies it was the custom to intrench on every halt, and I recollect—I think it is in Colonel Fletcher's work—there is a remark that in the advance of the Confederates from the James River, they made three halts in the day, and on each occasion they intrenched themselves, covering themselves in the first place with a bullet-proof parapet in 40 minutes, and in a very inconsiderable addition to that time, with effective cover against field guns. This remained the custom of both armies on all occasions whenever a halt was made. I do not know whether any experimental arrangements have been made in our service for testing the value of this tool (see fig. in paper), but the observation made upon it by Captain Ross is so valuable that I will read it again. "This small and light intrenching tool has done considerable service, not only, as will probably be remembered, by the Roumanians at Plevna (who have got the portable spade), but also by the Austrians in the Bosnian Campaign; during the latter operations, Szapary's Division, which was acting independently, and which was repulsed by the Bosnians, found the greatest advantage in the use of this spade, and it is really astonishing what it accomplished." This is a practical suggestion which evidently deserves very considerable attention, and might very well become the rule of the British service, using it in place of the cumbersome tool to which our pioneers have been accustomed. I recollect, speaking of the difficulty of getting troops to work in siege approaches on many occasions, that the "Times" remarked that the British soldier gives up the arms of Ceres precisely because he wishes to take up the arms of Bellona, and he does not like the earthwork when he can do otherwise. But with regard to these exceedingly useful weapons, a good deal might be done. It is very remarkable also that the English armies, I believe, were more in arrear with regard to intrenching matters than any armies of the Continent. I remember Sir John Jones, R.E., the first engineer Officer who published a connected history of the sieges of the Peninsula, remarks that: "Whenever we could get hold of a French sap and take the French intrenching tools our men always preferred those to the English." With regard to the approaches, there is one advantage possessed by the French soldier; because, being a man of considerably narrower frame than the Englishman, he has a great advantage in underground work; he also had the advantage of a tool of which our soldiers—and soldiers are the best judges in these cases—were not slow to perceive the use. With regard to the ammunition service, I have received instruction which I shall, I trust, not forget, as to the way in which the cartridges are packed in the expense pouch. This is a most ingenious principle, and is exceedingly valuable, where there is time to make preparations on service, for supposing that we require a larger number of cartridges made up, I do not believe it is at all impossible to do so on the field, or at all events with the artillery park. I may mention the Sardinian mode of arriving at the same end, though it is by no means so neatly arranged as in the Austrian. I was inspecting the packs of one of the infantry regiments, and on the top of the pack I saw a long pocket which was too narrow for boots, and I thought it might possibly be intended for the light shoe which the Italian soldier, favoured by the climate, carries. I found, however, that this was intended for the spare ammunition. It was set on the top of the pack, and as the expense pouch required replenishing, the soldier simply undid the button of the pocket, lifted one shoulder, and the cartridges dropped into his hand. There is one point which we must

congratulate ourselves that the lecturer has noticed, that is, up to a certain point. He says: "I must notice the care that prevails in Austria to preserve the full complement of men in the ranks, and not to fritter them away in other duties, which often impair the fighting strength of the army. I have drawn out a table showing this, and it will be observed that Officers' servants, carriers for the wounded, drivers, &c., do not belong to the fighting effectives of the battalions, and they are classed as non-combatants." One of the great faults of the British Army is that so many men are away on command. I obtained some returns of the field state on two special occasions at the Salisbury manoeuvres, at which the absence of the men was very marked indeed. Even in the corps which I believe were then put together better than we have since had at any manoeuvres, the deficiency of fighting men in the ranks was very striking; and I remember perfectly well at the great march past at Beacon Hill, seeing scores of soldiers who ought to have been, if not in the ranks, at all events massed in detachments, so as to be available in any emergency, hanging about, because they were not exactly detailed for special duty. What do the French do? At the great manoeuvres at Chalons, on one occasion, a *corps d'armée* consisted of 22,000, and 21,000 were on the field. It was true that great efforts were made, and probably the hospital tents were left in charge of one or two orderlies, while the nurses of charity also had charge of the sick; but I take it the real moral was that the dinners were all cooked, and the men cleaned up and bound to be in their places in the ranks as they might have been if they had been required to be under fire. I take the liberty of mentioning these three points in illustration of what we have heard from our lecturer to-day, and if I had time to read the details of the lecture, I am quite sure I should have found a great deal more than was worthy of favourable remark.

Major-General HIGGINSON, C.B.: Although I had the misfortune to come in late, so that the earlier part of the lecture was lost to me, I still heard quite sufficient to confirm an impression which I feel, and which I believe all my contemporaries feel, that the whole question is one involving such an outlay that England will never grapple boldly with the subject of supplying an army in the field, whether in the matter of transport or supply, but I fear that she will trust to the chapter of accidents, hoping that when the time comes the difficulty may be met as it arises. It is impossible to have listened to the latter part of the lecture without becoming sensible to the ramifications into which these subjects of supply and transport admit of being divided; and when we consider the *depôts* which Continental armies conceive it necessary to keep up, and how little we ourselves venture even to approach the subject, I think every soldier who looks forward to the possibility of a sudden call to command a large force must feel considerable fear lest he should be unable to meet the demands which will evidently be put upon us in a very short time. With regard to one or two remarks made by Lord Wavenny about the intrenching tools, I think our Chairman will admit that I am right in stating that, during the siege of Sebastopol, the comparison between the English intrenching tools and the French was decidedly in favour of the English. I had to be constantly on duty alongside of French working parties, and I see another gallant Officer (General Herbert) who also knew something about it, and he will bear me out, when I say that our men would no more touch a French intrenching tool than they would go to France at this moment for a pickaxe or a shovel to dig in their garden. The supply of ammunition has been a subject well thought out, because attaching ammunition to a knapsack has always been considered a very dangerous thing to do. If a knapsack is lost, away goes the ammunition with it. A man may be sometimes placed in a position where it is necessary to throw away his pack, but certainly he does not desire to throw away his ammunition in so doing. It is therefore not considered desirable by those who have had some experience in the matter, except in the case of an extra supply, that men should carry ammunition in their knapsacks. With regard to the employment of the supernumeraries in the ranks to act as Officers' servants, and to do the work of the camp, there, again, it is only a question of expense. We know perfectly well it is provided for in our regulations that a regiment has to furnish cooks, pioneers, Officers' servants, and whenever an emergency arises, clerks, assistants to the Commissariat, assistants to the ambulance, the Army Service Corps, and all this is so perfectly well known to the commanding

Officers, that they provide for it to the best of their ability, and always without grumbling, because they know that the organization of the army does not admit of these separate corps being completed to their full strength during peace organization.

Lord WAVENEY: With regard to Beacon Hill, I spoke of the idlers who were hanging about.

General HERBERT: Having been on the Staff of the Army Corps at the Salisbury manœuvres, I feel called upon to explain that Lord Waveney is mistaken in imagining the idlers he observed belonged to the corps present on parade, or that they ought to have been on parade.

The only absentees from the regiments in the *Corps d'Armée* to which I was attached were the cooks, a small guard for each camp, and the sick.

You must remember that, on the occasion alluded to, each regiment had a transport, the men of which were taken from the corps; this transport was not allowed to march past, and these were the men Lord Waveney imagined were idlers from the regiment on parade. There were also detachments sent down to do the duty of the head-quarters. We had a company attached to the head-quarters of the army, and these men, of course, did not march past; they belonged to no regiment on parade. I am perfectly sure that there was not a single man who could be in the ranks who was not there.

Lord WAVENEY: The remark I would make is a very distinct one. I cannot understand, when a force is in the field, that there are any men who have arms within reach who are not under arms. If they are not employed in marching past or in the manœuvres of the day, they might appear and take their position, and, in fact, we are left under an uncertainty if they be not there as to what our force of men is.

General HERBERT: If you remember, there was great discussion on that occasion, whether the military wagons should march past. There were two roads leading to the Beacon Hill position, by which the troops were obliged to come, and if the Army Service Corps and the Regimental transport marched past, we calculated it would take from three to four hours to get on the ground, and that was the reason they did not attend.

Colonel BLUNDELL, Grenadier Guards: I should like to draw attention to the fact that the General commanding the line of communications does not appear to be subordinate in all matters to the General Officer commanding in the field, and the Austrians have so often suffered in previous wars from not giving the General Officer commanding in the field full powers, that it strikes one as singular. The next point I wish to ask is whether the spades carried enable the army to dispense with tents, because if they do, of course they lighten very much the baggage. Then it appears that the men employed are not included in the ranks, but are considered as non-combatants; General Higginson mentioned the enormous calls that are made upon infantry battalions in this country.

The CHAIRMAN: I may mention in explanation of what Lord Waveney said that in the general returns one column is headed "on command," and another column "otherwise employed." They are two distinct things. One is "command" on which the troops are sent on duties or detachment; the others refer to those employed on the service of General and other Officers in the orderly room, in hospital, &c. There are two different columns.

Colonel BLUNDELL: There are also the cooks and men employed as servants, and otherwise in our army, not only servants to the regiments themselves, but servants to Staff Officers of militia regiments. Directly a little war occurs, the battalions at home are at once drawn upon. I notice in the paper that the Austrian train is supplied from other sources in war, but in England, directly a war occurs, the small battalions at home are drawn upon for every purpose. They are called upon for volunteers for regiments in the field, for volunteers for the Army Service Corps, the Army Hospital Corps, and for men to supply the places of those who have gone abroad. They are also called upon to send soldiers to the militia as sergeants and instructors, and to find regimental transport to supply the places of men who have gone out in the transport train abroad. I mention this particularly at this moment, because to-day there is a new organization of our army which places 43

battalions at an establishment of 480 men; and if those battalions already depleted, as I have stated, of many efficient soldiers were raised to war strength, they would be raised to 950, at least I believe that is the number given to the regiments of the First Army Corps. Now it is impossible that a regiment can at once assimilate the difference between an unreal 480 and 950 without losing its characteristics. The idea of this scheme, according to a statement published, I think I may say with authority, in one of the periodicals, is that we should send out two Army Corps, or rather, I believe, 60,000 men, for a great war. We have had a list of the troops of Austria, and I believe they are the smallest of the Great Powers in Europe, so we may judge what the effect of two Army Corps would be in a great war. We know that the population of the Northern and Southern States of America together was not larger at the outbreak of their war than our population at the present time. The Northern States started in the same way to make a little war. Their idea was, in three months, with 70,000 men, to finish their war; that was the Northern view, but they marched more than 2,000,000 men before they had done. I imagine when people talk of sending out two Army Corps for a great war, the idea is that this country would have to be educated up to the efforts it would have to make, because if we got into a great war with a Great Power, single-handed, we should want to win, and if two Army Corps would meet a Power of this kind with the assistance of some half-trained men, well and good; but if not, we should have to send more than two Army Corps, perhaps twenty Army Corps would eventually be employed, otherwise we should have to give way. I think that in this Hall at least we must look at things in the grey light by which a lawyer would look at a matter of fact, and not as the politician may like to consider it. I contend if such an emergency occurred again as has happened within the last two or three years, you would at once have to raise all your battalions to a war footing; I therefore would urge that no battalions in this country should be reduced below such an establishment as would permit of its being expanded to the war establishment without losing its characteristics, and that if necessary, if we cannot afford to pay for more soldiers, the war strength of the regiments in the First Army Corps should be reduced, and they should be sent out to little wars at a small establishment of, say, 700 men, so that we might, if possibly we had to make a great war, really send out a respectable force. Everybody knows that our real reserves in this country are the Militia, Yeomanry, and the Volunteers, and the men who have passed through the Army, the Militia, or the Volunteers, and the time which the British Channel gives us to weld those men and civilian recruits into a fighting force, time which we must recollect no other nation in Europe now has, because their frontier may be marched over, and they may be paralyzed in a short fortnight before they can act. That is not our case. The other point I wish to mention is the District Arsenals. We are told that the Austrians have arsenals in each district. Inconvenience, even in peace time, is felt in this country from not having district arsenals, and one of the things that paralyzed the first movements of the French Army in 1870 is stated to have been the great difficulty of getting all their wagons from one arsenal. Then, with regard to the regimental transport, may I ask whether the regimental transport is always kept horsed, and whether the men in the regiment ride, or whether sections of the train are attached for that purpose? ¹

Mr. Commissary POWELL: May I ask the Lecturer to be kind enough to explain the relationship which exists between the Train and the Intendence?

Surgeon-Major EVATT: Having served in Afghanistan upon the Line of Communications between Cabul and Peshawur, I wish to point out the constant change which took place in the *etappen* stations by the rule that the senior Officer present shall command on the march in. For example, in three or four days, three or four separate commanding Officers march in, the senior Officer always superseding the junior Officer. As long as the front of the army is looked upon as the sole place for getting rewards and honours, and the communications are not recognized as being most valuable, so long Officers will press forward to the front, and the consequence

¹ Regimental transport, though very convenient, is very expensive, and to prevent any conflict of authority as to the employment of the transport on general service, it appears best to attach sections of the Army Service Corps to regiments.

is you get a new man in command of the *etappen* station who knows nothing whatever about the district. It is most important that the Officer who commands each *etappen* station should be appointed at the beginning of the campaign; he should have a Staff Officer with him, and they should remain there throughout the campaign, knowing that if the work is well done they will not be forgotten. It constantly happens in our service that the rush to the front is very great, and the reason is that in the front honours and rewards come, not along the communications. In the Afghan Campaign, the knowledge of local tribes, of water supply, of where supplies could be got, the knowledge of dangerous parts of convoy routes, these things are all important to the *etappen* commander of each post on the Line of Communications; but if an Officer marches in, and because he is Senior Officer present, takes command of a station, he is perfectly ignorant of these important matters. I would, therefore, point out how important it is that the *etappen* commandant should be a permanently appointed Officer, and should come back with the army, and not till then. If not, you will always have strange men coming in; and I take it, unless the place is actually attacked, the Officer appointed by the General should have the supreme control there. Much has been said about the withdrawal of non-commissioned officers from the battalions; this case occurred to myself. I was in the field hospital at Dakka during the war, and being at times very badly off for men, I went to a Colonel and said, "Will you give me some men to look after my hospital work?" He said, "My dear sir, there are forty of my non-commissioned officers away now, they are doing transport work and signalling work. I am very sorry, but "if your hospital is to succeed at the expense of my regiment, it certainly will not "succeed," and he was quite right in saying so. What we want is an Indian Hospital Corps well looked after, and sufficiently strong to do the work of the service. It is impossible to expect me to make bricks if you give me no straw, and up there we were very often short of men, because we have no Hospital Corps in India. When we have an efficient Hospital Corps in India, then and then only will the Medical Department work properly.

The CHAIRMAN: There is no doubt that the important difference between our service and the Austrian is that we take off from the actual bayonets of the service a great number of men that certainly ought to be put into a different category on the list. I have always reckoned, as far as my experience went, that if I had 8,000 men to command I should only get 6,000 bayonets; one-fourth of an English army must really be taken off for sick and otherwise employed. It is all very well when you send an expedition of 40,000 men to say that you have 40,000 fighting men; it never is the case, therefore we may fairly say that other armies give their real state of fighting men better than we do; they also have the efficiency of these extra corps in a much better state because the men who are accustomed to be the hospital men on the field of battle or the hospital men in the hospital tent are much better fitted for the purpose than men merely taken from the ranks, perhaps in a hurry, to do that duty, which is very essential for the whole army. I should like to know more about the ammunition. I see that battalion ammunition is carried in the battalion ammunition wagons. If I remember rightly, Herzegovina and other parts of Austria are mountainous, and I should be glad to know how it would be possible for an infantry battalion to get its ammunition up to some of those disagreeably rocky and high places. I have always heard that by far the best means of getting ammunition to the infantry soldier has been that the first reserve should be upon pack animals, that is to say, that about 30 rounds per man belonging to the battalion should be ready at hand for the battalion under all circumstances, and not depending upon wheeled carriage, which may block the whole of the road, or may not be able to get to the place where it may be most wanted, namely, the top of a hill.

I should think a curious confusion might take place by the titles of the two officers, viz., "the General Officer Commanding the Army" and "the Army General Commander." I do not know how it might be expressed and understood in German, but in England it would make rather a confusion as to whom reference is made. The point is that the general command or commandant is independent of the General in command in certain cases. I do not know whether that will answer with foreign nations; I do not think it would answer with English troops. The

General Officer in command of the army in the field must be in command of everything connected with the safety of the army. He has those under him from whom he can exact obedience, and therefore he must be in command of the whole, and responsible as far as his authority goes for those details of the army which are so essential. I will now ask Mr. Ross to reply to the questions that have been put to him.

MR. ROSS-OF-BLADENSBURG: The Austrians transport their small army ammunition for the battalions in mountain warfare on pack animals. As I said at the end of my lecture, the mountain organization is not yet definitely established; but the idea is, that battalions should be supplied with so many pack animals to carry the ammunition in the field; also that the Brigade parks and the Divisional parks should be similarly transported. The Austrians divide their mountain organization into two formations; they call the one the "normal mountain organization," which is composed exclusively of pack animals, and the other the "mixed mountain organization," composed of pack animals combined with a certain number of vehicles for roads in the larger valleys. But all battalion reserve ammunition has to be carried by pack animals when operations take place in mountainous districts. I do not think the Austrian ammunition wagons, as they are at present, are to be advocated, although they carry a great many more rounds than we do. We have three battalion carts, containing between them 30 rounds per man; whereas the Austrians have two large four-horsed wagons for each battalion, containing some 53 rounds per rifle; they have thus a larger reserve of ammunition near the men, but with this disadvantage, that they cannot get their heavy wagons into many places where we can get our smaller carts. Their reserve ammunition cannot therefore follow the battalion as readily as ours, and I therefore think that our system is distinctly the best of the two, excepting, of course, that we get a smaller number of rounds than they do.

Regarding the infantry spade, I believe experiments are going on in England; and perhaps a very much better intrenching tool than the Linnemann will be adopted. I by no means wish to say that the latter is the best that has been invented; all I wish to point out is that it is a very good spade, because it has done excellent service both at Plevna and in Bosnia, and I think practical experience is the best test. The book I referred to also shows that the trenches excavated by it were very much larger than you would suppose that little implement could make. A portable infantry spade is a very necessary part of a modern soldier's equipment, and I hope we shall get one in the English service.

I should like to say a word on the pioneer equipment (I do not mean that of the "Pioneer Corps," but of the pioneers of battalions), because in these little matters of equipment I think, perhaps, we have yet something to learn from the Austrians. The battalion pioneers are furnished with a chain-saw.¹ This is a chain, and on each link there are a couple of steel teeth; when a man carries it, he rolls it up into a sort of coil, four to six inches in diameter, and it is put into a small leather pouch; when it has to be used, it is stretched out and used as a cross-cut saw by two men. It seems to be a very simple and useful arrangement.

I omitted to state that in each of the field units (divisions, army corps, &c.) there are in Austria one or more companies of infantry (called *staff infantry*) attached to head-quarters. They do not belong to the regiments composing these units, and they do all the orderly duty, &c., so that the troops in the field are invariably kept up to their complete war strength.

With regard to the duties of the "Army General Command," I have taken them directly out of the Austrian Regulations; but whether the system is good or not, I hardly venture to say.

There are no tents provided in the Austrian Army, except in the mountain organization; but then only for the head-quarters of the various corps.

One gentleman asked me a question regarding the relations between the Military Train and the Intendance. The former is not under the latter, in a military sense, but is subordinate to its own Officers and to the Inspector of Military Train (or

¹ There is a drawing of this saw and case in "Emploi de la Pelle d'Infanterie," by Captain Borneque: Paris, 1880, p. 22.

commandant) at the head-quarters of the particular field unit to which the train squadron is attached. The Transport Officers are responsible that the sections under them reach their destination. The supply columns which are a portion of the train squadrons are accompanied by a Supply official, whose business is to look after the stores, the Train Officer being obliged to see that the wagons are not delayed in their march; in this case, of course, the latter must take his instructions from the Intendance, who says where he has to go to, but he is not under them in a military sense. I should explain that the Austrians call their administrative officers "officials," the term is *Beamte*, they drive about in carriages which are provided for in the Squadrons of Train; ¹ their duties are all-important, and I have already alluded to a part of their sphere of action in my lecture, but I do not think they exercise any military command.

The CHAIRMAN: I have to ask you to thank Mr. Ross for his lecture. The subject is a very interesting one, more particularly to England, for in our service there is such a deficiency of that transport and of that means of moving it without which an army is positively helpless, that it is most important that we should ventilate the subject as much as possible, and persuade those who have to find the money that without movement an army is positively useless.

¹ See Table, p. 808.

Monday Evening, April 11, 1881.

VICE-ADMIRAL J. H. SELWYN, Member of Council, in the Chair.

ON RECENT EXPERIMENTS IN SCREW PROPULSION.

By ROBERT GRIFFITHS, C.E.

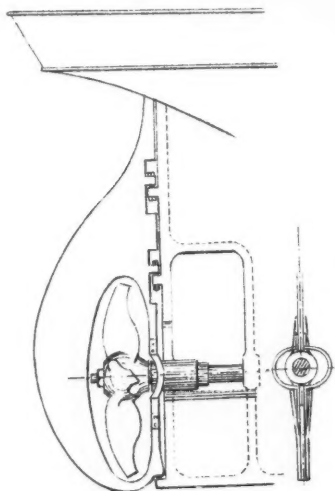
IN the paper that I had the honour of reading before this Institution two years ago,¹ I explained the importance of placing the screw propeller a suitable distance aft of the sternpost, and the Committee have afforded me an opportunity this evening of further explaining one or two methods by which ships built with the ordinary arrangement of the stern and screw-frame may be altered to the system.

Perhaps I may be allowed, before proceeding to the subject of this paper, to give as briefly as possible the reasons which account for the increased speed obtained by placing the screw propeller in the position which I advocated in my former paper, for it is necessary to be acquainted with these in order to understand the advantages that will result from altering ships in the way I now propose.

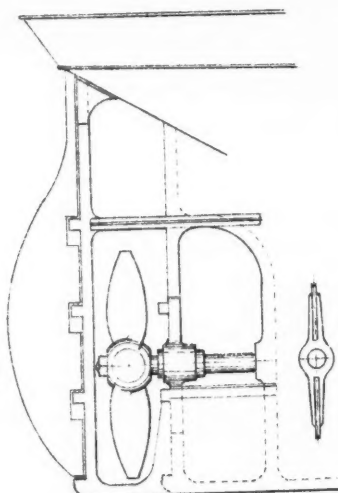
The chief cause of the inefficiency of the screw propeller in the ordinary position is that the screw, by drawing away water which the ship would otherwise carry with it, and by altering the currents which flow by the stern of the vessel, reduces the pressure which the water exerts on the run; this leads to an enormous increase in the resistance offered to the ship's progress, the increase in the resistance being usually from 40 to 50 per cent. of the resistance which the ship would otherwise have, a fact which has now been known for several years. When experimenting with a view to reducing this loss, I some years ago discovered that if I moved the screw from the ordinary position and placed it further aft, the speed of the boat increased, the increase being considerable for a small alteration in the screw's position at first and less gradually as the screw was placed further aft, and that when the screw was two-thirds of its diameter from the sternpost the maximum speed was obtained, the speed being slightly reduced by placing the screw any distance greater than two-thirds of its diameter from the sternpost. Further experiments proved that the increase of speed was principally due to the reduced resistance of the ship when the screw was placed further away from the tapered part of the hull, but that the amount of thrust given by the screw depended on its position with respect to the closing of the currents behind the stern, for these currents after meeting flow (relatively to the ship) in a direct line aft, and when the screw is behind the point at which they meet, it meets with less resistance and gives less thrust than when forward of that point. Hence, as I stated in my former

¹ See Journal, No. CI, vol. xxiii.

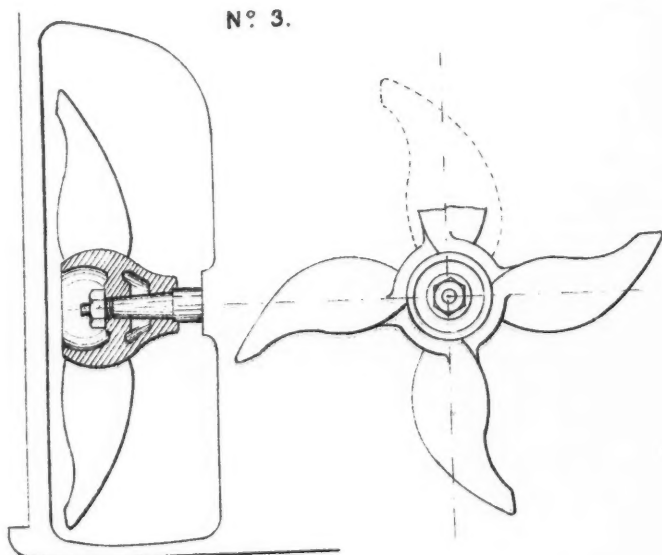
Nº 1.



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paper, if screw ships were built with very wide screw-frames and the screw placed so that it is two-thirds of its diameter from the stern-post, a speed 12 to 15 per cent. greater than that which is now obtained would result with very much less vibration. Vibration, I find, is caused chiefly by the enormous resistance offered by the dead-water to each blade in succession as it passes the upper part of the disc, and by the screw being placed further aft this is avoided.

I will now proceed to the subject of this paper, namely, a description of some method by which existing ships may be altered so that the screw propeller can be placed two-thirds of its diameter from the stern-post.

In the first arrangement shown in Diagram No. 1, it will be seen that I remove the screw from the screw-frame, and cut the rudder-post, in which a bearing is inserted; the screw-shaft is lengthened, either by putting a short piece between the couplings inside the ship, or by welding a piece on to the end, so as to pass right through the frame and through this bearing in the rudder-post, and the screw is placed aft of the rudder-post: this brings the screw about the right distance from the hull of the ship, and for affording additional strength to the rudder-post, the bottom part of the frame may be plated over as shown. A new rudder is used, the form being such that it will leave room for the screw to work in. From the experiments that I have made with this form of rudder, I find it requires to have much less surface than the ordinary rudder to give the same effect in turning the ship, for when the surfaces of the two rudders were of the same area, the rudder of this form would turn the ship equally as fast and in the same space as the ordinary rudder, though the former was only put over a little more than half the angle that the latter was. Another advantage connected with this form is, that when the screw is not working, the rudder is able to steer the ship efficiently, whereas the difficulty of steering many screw ships under the same conditions is well known and has led, in the case of machinery breaking down, to disastrous results.

In the second arrangement shown in Diagram No. 2, the essential difference, compared with the former one, is that instead of using a new rudder of this form, the ordinary rudder is used, it being suspended on a new frame placed behind and firmly attached to the ordinary screw-frame; this is an arrangement which might be preferred by some people, though I myself should give the preference to the former one, but in either case the increase of speed depending simply on the screw being moved away from the run would be the same.

In Diagram No. 3 is shown a screw propeller which can be applied to ordinary ships without any alteration being required; this screw comes close to the rudder-post, and with an ordinary width of screw-frame the substitution of a screw of this form for an ordinary screw gives an increase of speed of from 5 to 8 per cent., or about half the advantage of the plan. Several screws like this have been made (and others are now being made) and have given a highly satisfactory result in each of the cases in which they have been applied.

The carrying out of the alteration shown in Diagrams Nos. 1 and 2 would cost a considerable amount, but this expense would be small in comparison to the value of the increase of speed that would result. To take a rough estimate of the value of increased speed; since the power necessary to obtain any speed is proportional to the cube of that speed, to increase the speed of a ship 12 per cent. would require the engine power to be increased 40 per cent. Now taking the value of the engines at 45% per nominal horse-power, for the first cost, the coal required for their consumption, the space occupied in the ship by the coal, &c., the wear and tear, &c., would at a very moderate calculation amount to a similar sum, so that an increase of 12 per cent. in the speed of a ship would be equivalent to an increase in the value of such ship of 3,600% for every 100 nominal horse-power of the engines that are in her, and compared with this, the cost of the alteration becomes insignificant.

The system of placing the screw propeller away from the sternpost has been applied to several ships, and these applications have confirmed the results anticipated from the model experiments. The ships which have had their screws placed as far aft in the screw-frame as possible (the arrangement shown in Diagram No. 3), are the "Retriever," "Elephant," "Great Northern," and "John Pender," and a small steamer out at Penang. In the cases of the "Retriever" and "Elephant," a knot and half a knot were gained respectively, and though measured mile trials were not made in the other cases, the owners were satisfied as to the advantage of the system; in addition to the increase of speed in each case there was a decided improvement in steering, and the vibration was much reduced.

In the "Grantully Castle," Messrs. Barclay, Curle, and Co., being satisfied from the trials they had witnessed of the advantages of the system, made the screw-frame wider than usual, and placed the screw well aft in it; the result has been very satisfactory, the "Grantully Castle" realizing as high a speed as the "Kinfauns Castle," a ship similar in most respects, but built of steel and of finer lines, in consequence of which she was expected to obtain a speed of at least half a knot more than the former.

After this, in building the "Adjutant," Messrs. Barclay, Curle, and Co. again partially applied the system, the screw being put rather further aft in this case than in the former, but the only comparison that could be made in this case was, that in her first voyage out, carrying half as much again cargo as the other vessels of the same line, she made a better speed with a lesser consumption of coal.

I will only mention one other instance: an engineer in the Turkish Navy, Mr. Evans, informed me a short time since that the officials over there, having seen the paper that I read two years ago at this Institution, determined to test the system, and had the screws of two vessels moved aft, in one case obtaining a knot more speed, and a result not quite so favourable in the other; he could not, however, inform me exactly how far the screws had been moved, but kindly offered to get me further particulars.

It is very probable that it will be a considerable time before this

system is largely adopted, but this was the case with my screw propeller. The subject of screw propulsion has been so little understood, and so many plans have been brought out, respecting which such great things were promised, but never realized, that shipowners and engineers are now inclined to think that no improvement is to be effected.

At the time I was bringing out my screw propeller, Mr. Lloyd at the Admiralty asked me what increase of speed I expected it to realize, I said about half a knot, and he replied that he was inclined to think that there must be something in my screw, as I was the first screw inventor he had known who was not going to get from two to five knots more speed by his screw propeller.

The smallest consideration will show the absurdity of the promises that are often made respecting new methods of propulsion, for when the amount of power absolutely necessary for propelling a ship is ascertained by its resistance in being towed, it is seen that in a ship of the ordinary efficiency, the power applied to the screw-shaft is only about 75 per cent. more than that required to tow the vessel, and consequently a perfect propeller, that is to say, one that neither absorbs power itself in friction nor interferes with the water at the stern of the ship, could only give a speed 20 per cent. more than the speed given by the ordinary propeller.

For a great many years, and until within the last three or four years, the general opinion of marine engineers was, that the great defect of the screw propeller was the slip. In 1849, I proved on a model that there was no loss of speed caused by the slip of the screw, and although I stated this generally, no one could comprehend it, but Mr. Bramwell, C.E.; afterwards, the experiment was repeated on a large scale on Her Majesty's ship "Flying Fish," but marine engineers still remained of the same opinion, and for years continued to give almost invariably the slip of the screw in reports of the trials. This shows perhaps as plainly as anything could how difficult it is to eradicate the erroneous notions that are entertained respecting screw propulsion, and the length of time required for bringing marine engineers to believe in any theory.

The CHAIRMAN: Gentlemen, I have now to invite discussion on the paper. Mr. Griffiths is known to all of you, and anything he says will, I am sure, receive the greatest attention from the members of the Institution.

Captain CURTIS, R.N.: We may compare water going through the arch of a bridge to a ship going through the water. The water goes through the arch, forced from behind. That causes a wave, and the water opens out and runs back against the buttresses. Any screw close to the ship, and preventing the influx of the water to it, detracts from the speed of the ship. Mr. Griffiths' experience is, that the screw should be two-thirds of its diameter away from the dead wood. This is right in theory, and no doubt is right in practice. I spoke to someone the other day at the Society of Naval Architects on the subject, and he said, "It is no matter, if the ship has a clear run aft;" but I think it does matter. If you take an orange pip and squeeze it, it will slip through the fingers, but if it had a tail, you would catch it by that. That happens to a ship, you catch it by the tail, or dead wood, so I think that if the water catches the tail of the ship, it should meet short of the screw, and not have to traverse round so far. There is another important matter. The ship, as Mr. Griffiths has told you,

with the improved rudder, will manœuvre quicker than one with the ordinary rudder. It is an important feature, not only in long but in short ships. They should be able to turn and steer better, and to avoid collisions, &c. The "Royal Albert" was not a long ship at all: it was built for a sailing ship with only 500 horse-power, and had a speed of 10 knots. The "Conqueror" was built for steaming, a much longer ship, 1,000 horse-power, and had a speed of 12 knots. I attribute to the "Royal Albert" a better performance on account of the screw being more deeply immersed, and the water coming in at the end of the ship having better effect. I may as well repeat what Sir William Thomson said the other day. The deep-sea lead, I think, is about 28 lbs. He said when he put it over the quarter of the "Livadia," it was something like a shuttlecock, so knocked about, so that you may imagine what a hubbub there was over it on the water coming in and the screw throwing it out, the water objecting to the vacuum behind the ship. He had to use a lead similar to the weight used to balance a steelyard. There is another point—if any gentleman can explain it—with respect to screw propulsion. When the "Serapis" was 2 feet by the stern she went 10 knots for twenty-four hours consecutively with a consumption of fuel of 50 tons: when she was on an even keel she went twenty-four hours the same speed with a consumption of fuel of 80 tons. I think that must be due in some measure to the water closing in behind the ship, and we usually see the steam yachts trimmed by the stern. There is another important point. We know very well the torpedo-boats were caught by the ropes off Fort Monkton. I would suggest, therefore, that there should be some protection to the screw. Mr. Windham, at the Wandsworth Torpedo-Boat Works, informed me that he put a ring over the screw, and that the screw would cut osiers as thick as your finger like a grass cutter. I believe the authorities object to having the screw encased, but I suggest that a semi-case should be put over the screw. I ask Mr. Griffiths if that semi-case would increase the speed, and allow the inflowing water to come without being acted upon by the propeller. Our thanks are due to Mr. Griffiths for his able paper. It is a subject to which I have given serious consideration ever since Mr. McInnis got the prize for an essay on the best screw. The fact is, he cut away the screw to certain dimensions, and he got more revolutions and better results, and I conceive it was only due to the screw not having the power to pump away the inflowing water. Every sailor knows that if you put a bottle behind a ship it will follow the ship so long as it keeps an even course, at a speed of 6 or 7 knots. I think every shipbuilder, as well as every member of the Institution, will appreciate Mr. Griffiths' labours, and I think they will prove a great boon to the country.

Captain BEDFORD PIM, R.N.: Mr. Griffiths is well known to all sailors as the father of screw propellers. He has done a great work for the Service, which I am sure owes him a deep debt of gratitude, and every gentleman present must feel greatly obliged to him, for the paper he has kindly given us to-night. I think he is quite right in thrusting the screw as far aft as possible, if it was only for the reason that there would be a greater facility in raising it. I am one of those who look at the days of sailing power as by no means departed from Her Majesty's Navy. All our ships, in my opinion, should be so constructed that they should keep to sea under sail as long as they have provisions on board. I think twin screws that drag in the water should give place to a screw that can be lifted, and you can then use your ships as sailing ships. The old "Satellite" would, I believe, give a good account of the "Nelson" or the "Northampton" of the present day.

Mr. JOHN HAYES: I am sure we are all much indebted to Mr. Griffiths for his valuable paper. He has, as is well known, done a great deal in the science of screw propulsion, but much remains as yet unknown. There is one recent improvement in the construction of propellers I should like to bring before the notice of the Institution, having already shown it to Mr. Griffiths, who speaks well of it, and thinks with me it is decidedly a step in the right direction. It is not one of the usual class of propeller inventions which from time to time are brought out, and which mainly rely on some supposed improvement in the shape of the blades, or refinement of pitch, &c., &c., but it is one applicable to every kind of propeller, and consists in simply constructing the screw in two halves, and connecting them by bolts and nuts of suitable strength: I refer to "The Split Boss Propeller." It is a plan that

is usually resorted to in the workshop when fitting pulleys on to a line of shafting. Anyone who has had to do with screw propellers knows that there is great difficulty in taking them off and replacing; with the split boss propeller, which has been recently invented and patented only in December last, with any ship going into dock the propeller can be taken off and a new one put on in a few hours, no matter how large the ship, while at the present time it takes as many days. Another advantage of this is that it facilitates stowage on board ship.

The CHAIRMAN: I think, Mr. Hayes, you should bear in mind that we are met here to discuss Mr. Griffiths' paper and not new inventions; but some time after this I have no doubt the Institution will be glad to hear of the invention you speak of; the principal point Mr. Griffiths makes is the movement aft of the propeller.

Mr. HAYES: I will then, Sir, conclude by asking Mr. Griffiths if, on moving the propeller further aft still, past the point he has already determined for the position of the propeller, whether a still greater efficiency is not obtainable?

Commander CHENEY, R.N.: The rudder propeller being removed further aft struck me as applicable to the Arctic regions, where the ice comes down upon us so suddenly. It may give a greater facility further aft to raise our screw in perhaps one-third of the time we took to raise it in former expeditions.

The CHAIRMAN: I am very glad to hear all that has been said on the subject. I shall try and do all I can to show how much I approve of Mr. Griffiths' work. I know that there are considerable changes in the blade of the screw besides in the position, and I should like Mr. Griffiths to explain how far he has found those changes beneficial. There are some screws, I think No. 3, which have not been brought to our attention exactly in that shape before. There is no doubt whatever in my mind that the question of the place at which the water driven aside by the ship meets again at certain speeds—for it varies at different speeds—is a thing to be very closely examined in choosing the position of the screw. Hitherto, I am sorry to say, as far as my recollection goes, we have made a ship with a stern-post and a rudder, and then we have cut a hole and put a screw in, notwithstanding all Mr. Griffiths has said and done on the subject, without any attention to anything else except the shape of the ship. We should take care where we place the instrument for the propulsion of the ship. All experiments show that when the screw has been placed in clear water, there has been a noticeable improvement in its effect. Twenty-four years ago, in Malta, I saw one that passed through the rudder and came out behind. Now, I see that Mr. Griffiths places his screws in the rudder. Admiral Ryder, I think, said that the upper part of the rudder in most steamships was the only active part. (I believe that with a hydraulic propeller, steamships can be steered without using the rudder at all.) He spoke of one of the large American liners, which had lost all but the upper part, and she steered as well as before. If we can do that, it is clear that the position of the rudder may, in a very large measure, usefully give way to the consideration of the position of the screw; and it is evident that then it will be further removed from the dead water of the ship, and from that closing in of the water which causes counter-currents, and is not in favour of the action of the rudder. There is one objectionable thing about the use of the screw, and that is the way in which, when the ship is pitching, it is apt to kick out of the water. If we could only get rid of that kick, which strains both machinery and ship, I should have more hope of the future of the screw as a propeller. I should like to know from Mr. Griffiths something about that. Within the last few days what I know is a very old proposal of Mr. Griffiths—putting a casing over the propeller—has resulted in a marvellous success. It has been recently done by another person, who probably would like to bring it before the Institution himself. The result is, a case like the *vena contracta* in shape enables the same speed to be obtained with only one-half the diameter of screw. It is clear this will give us a great power in immersing the screw more. And it has given another extraordinary effect. It enables the rudder, however curious a shape it may assume, to turn the ship right on her heel from the rapidly flowing water out of this casing impinging on it. But Mr. Griffiths will readily admit that the screw in such a casing is like a hydraulic pump, and must be considered in that light and not as a mere screw. However this may be, it is clear that now, for the first time, we have got rid of what Mr. Griffiths saw and wished to eliminate years ago—got

rid of that accompanying radial disc of water. The reason why we cannot put on to the screw the power of high speed engines is, that if we do, the screw forms for itself a very curious disc of water. I have seen it once or twice in my life. Assuming that the screw is revolving at the speed for which it is proportioned, there are conditions under which, if that screw of a certain pitch and diameter is revolving at much higher speed, it will form for itself a casing of water of lenticular shape, which it will carry round with it, and the whole effect of propulsion will be gone; there will be nothing but the disc of water covering the screw, and exerting no push whatever, but permitting the racing of the engines. It is a case which is very seldom observed, but which, nevertheless, has a real existence. (Captain CURTIS: I have done that with an Armstrong wheel.) This tube or casing of which I speak has a very large mouth compared to the size of the screw. The opening is very wide, and it follows the law of the *vena contracta*. It contracts at the point where it gathers all the water, and the screw throws it out with the least possible resistance; and that is the way in which I understand those results have been obtained. Meanwhile Mr. Griffiths must have the credit of having foreseen that a casing round the screw would do away with the evil effects of radial action. Some people fancied they must always have a big screw, and then, without considering whether they could not do with a smaller screw, their objection was to having a large casing before they knew what size the casing would be. I am sure you will give Mr. Griffiths all credit for what he has proposed, as well as for what he has done. I have noticed what Mr. Griffiths has said as to the enormous percentage of saving promised by inventors on almost all operations. It is a common thing to hear a man say he is going to save 120 per cent. of the power employed; in short, he is to do the work with 20 per cent. less than no power at all. It is a foolish thing to say, and the way inventors have of putting it operates too often as a caution against themselves and their statements. The rudder which is used with the new hydraulic machine I think is worth understanding. It is brought down behind the aperture of the casing, and Mr. Griffiths' boss being applied to the screw forms a cone, and then the rudder forms a continuation of that cone, and proves to be the best rudder you can have: it turns the vessel on her heel. All these are novelties, and I hope we shall get better effects with a variety of such novelties in hydraulic propulsion than those obtained here; but none of the screws of this kind can be properly considered, except as hydraulic propellers. Undoubtedly Mr. Griffiths is the father of many of these improvements, and he deserves our best thanks and the thanks of this Institution for his persistent efforts to improve modern propulsion by the screw.

Mr. GRIFFITHS (in reply) said: In regard to the remark made by Captain Curtis about the flowing of the water beneath the bridge, he is quite correct, and if you follow the water further on beyond the bridge you will find the water turns back and goes forward. A similar action takes place behind a ship, in consequence of which, when the screw is placed beyond where those currents meet, loss of speed results. In regard to the formation of the rudder, when I tried this form of rudder shown in Diagram No. 1, I made the surfaces of this and of the ordinary rudder exactly alike, and when I moved this new rudder to an angle of 20° it turned the ship exactly in the same time and in the same circle as the other did at an angle of 38° ; that is, the new rudder was very nearly as effective at half the angle. Now, as to putting the screw in a casing, I have experimented for years on that subject, and I always contended that eventually the casing would have to be adopted in our screw ships; for the first time our men-of-war go into action they are almost certain to meet with some accident by wreckage coming in contact with the screws. Of course, if the screws were in a casing they would be perfectly protected. As to the speed, I could obtain a better speed with a casing of suitable form than I could with the screws in the open. When I experimented on the steering with the screw in a casing I only tried the ordinary rudder, and it is quite novel to use a cone for the purpose; but the water meets in the centre, and has an enormous force towards the centre near the boss of the screw. The reducing of the screw in diameter and lowering of it in the water has considerable effect on its efficiency. The great impression among engineers for years has been that the better effect obtained by keeping the screw lower down is due to getting more solid water for the screw to act upon. That is quite an erroneous idea. The screw draws away less of the dead water as you

lower it down, and there is a gain, but the gain is because the dead water which is at the top of the screw's disc is less interfered with, there is no dead water below the screw-shaft. I have experimented to find out what was the speed of the water when the screw was working, and when the boat was lowered and the screw not working. When the screw was not working the speed of the water down below the screw-shaft was just the same as at the side of the ship, but above the level of the screw-shaft the speed of the current was much less, in fact, at the top on the forward side of the screw's disc, the water goes with the ship. I have come to this conclusion: we have had so many opinions of engineers, and so many papers read advocating plans which have turned out to be absurd, that I do not believe engineers like to say a word about the subject. As I have said in the paper, it was twenty-seven years before they found out there was no loss by the slip of the screw. Now, consider what an important instrument the screw is, and yet it took twenty-seven years to find out such a simple fact with regard to it. What is the use of trying to persuade them now? Even Mr. Froude, whom I argued with, would maintain that there was a great loss by the slip of the screw; but within the last three or four years he stated that the worst screw was the one that showed the least slip.

The CHAIRMAN: I am sure it is the opinion of the meeting that we ought to return the thanks of this Institution to Mr. Griffiths for his very valuable paper.

Monday Evening, April 11, 1881.

VICE-ADMIRAL J. H. SELWYN, Member of Council, in the Chair.

HANDLING OF HEAVY ORDNANCE.

By GEORGE FAWCUS.

It may be considered a matter of national importance to direct attention to the state of the first line of our floating defences, and to the rapid equipment of British merchant ships and steamers as armed auxiliary cruisers, transport, and store ships for self-defence. The following proposals, therefore, will be interesting to many, as intended to increase the practical efficiency of all land and sea service guns, by reducing to a minimum the difficulty of moving them, and also at the same time obtaining the additional advantages of so fitting guns as to combine the "end-on" and "broadside" fire—enabling muzzle-loading guns to turn round horizontally, or revert vertically, with rapidity, and to load in rear, on a flank, or in any convenient position under cover.

The means of obtaining these *desiderata* have suggested themselves by the study of the action of the trammel or elliptograph, by trying an elliptical movement on two moving and revolving pivots working on straight lines, and guided, directed, and controlled by the very simplest contrivance possible for obtaining at the same time an easy, balanced, and steady motion in whatever direction it may be required to move the heavy mass, otherwise most difficult to turn round. In connection with the handling of guns, and the laborious work of the gunner in the collateral questions of repository practice, their mounting and dismounting and their transport should also be taken into consideration, as being decidedly affected by any facilities for moving them more easily, as well as in the operations of trailing right and left, or in naval practice, training, and traversing.

In steam vessels there are many facilities for applying steam-power in various ways to work hand-gear by shafting, and drums for belting, bevelled-wheels, clutches, steam-winchies, windlasses, &c. With the action direct on a straight line other mechanical aid can be applied as motive power. As, for instance, the worm screw and nut, which is a strong controlling power, and acts both ways at once, like the two tackles, one on each side. When the action of an ordinary worm screw and nut is too slow, one with a longer turn or coarser thread, approaching even to the long twist of the rifling of a gun, can be used, so that a turn or two of a rifled bar would run the nut rapidly along a great distance. If this movement were applied to the working of a naval gun-slide, it would act both as port-training bar and

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FIG. 1.

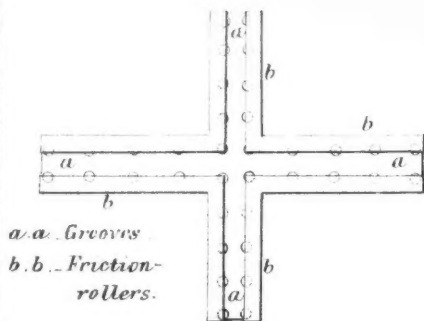


FIG. 2.

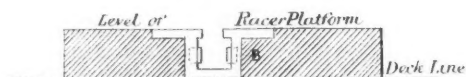
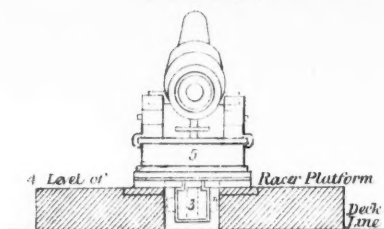


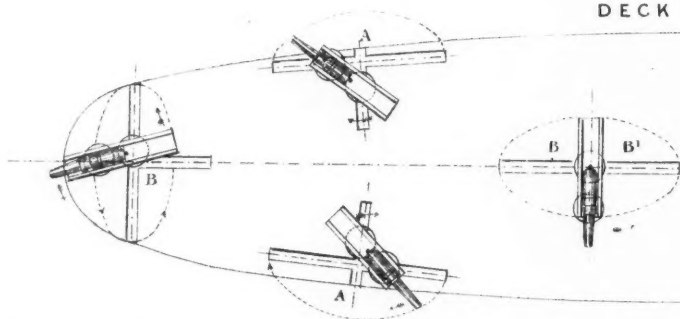
FIG. 3.



REFERENCE TO FIGS. 1, 2, 3 and 4.

- 1.—Traverse platform or slide.
- 2.—Turntables.
- 3.—Pivot wheels.
- 4.—Level of platform.
- 5.—Racer.
- 6.—Deck line.

DECK PLAN.



EXPLANATION.

- FIG. 1.—Ground plan of grooves and friction rollers.
 „ 2.—Section of grooves in racer platform.
 „ 3.—End-on view of gun, mounted on slide.
 „ 4.—Broadside view of gun, showing both turntables.
 „ 5.—View showing gun in the act of turning.
 „ 6.—Deck plan. A.A. Broadside guns, oval longitudinal barbette turret.

Note.—No recoil arrangements are shown.

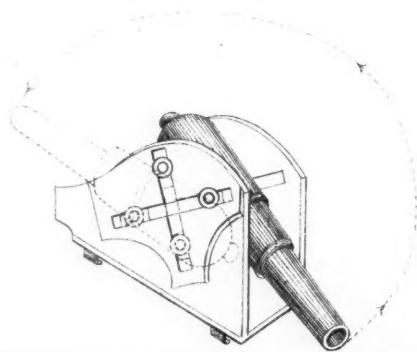
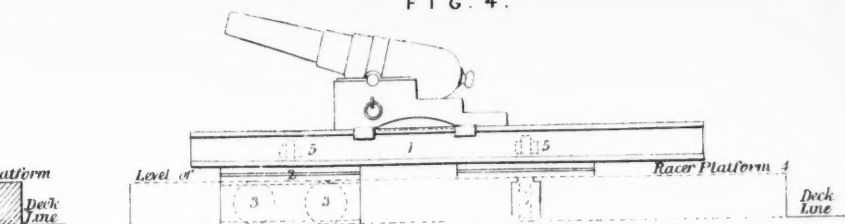
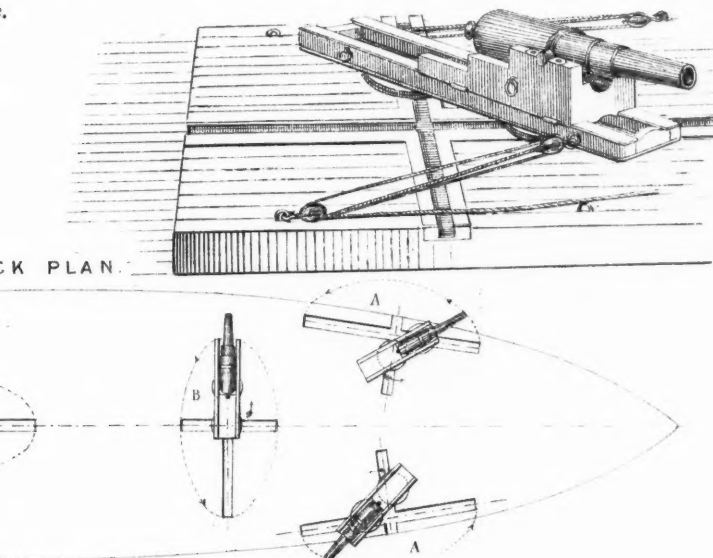


FIG. 4.



3 and 4.

FIG. 5.



EXPLANATION OF PLATE.

es and friction rollers.

racer platform.

mounted on slide, showing turntables, and the rear pivot wheels in its groove.

, showing both sets of front and rear pivot blocks and wheels.

the act of turning by its gun-tackles.

roadside guns, half round fire. B.B. All round fire. B 1. May be protected by an

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breeching gear to prevent recoil, and tackles, all combined for a half-round movement with the screw either in front or rear as required for sweeping round 180° . In a similar manner a straight rack-racer can be used instead of one of an elliptical or circular curve, with a wheel and pinion purchase. Machinery exposed to the risk of injury in action, or in the working of a vessel at sea, must be supplemented by hand-gear for manual labour in case of need. The more the working of guns is kept down and protected from exposure, the less will be the danger of injury. It must be an advantage if these supplementary appliances can be improved upon so as to develop a more complete application of steam or hydraulic power, or, if possible, elaborate an easy practical method of rendering manual labour not only more effective in itself, but effective also in combination with new appliances for economy of power, time, and space. Stability and compactness—that is, sufficient strength without unnecessary weight of structure—freedom of movement with the least possible amount of friction, must be preferable to the dead drag and heavy pull of main strength as in the case of clumsy primitive constructions and appliances.

Stability of movement is best attained by “a sufficiently broad bearing of base to throw the centre of gravity within the line of support,” and it is astonishing how easily a heavy mass, when properly balanced, moves round on a single pivot. A proposal to balance a moving weight on two moving pivots to assist each other, should therefore be right in theory and principle, and if fairly tried in practice, should act properly as helping to promote a combination of stability and freedom of action.

The question of transport is very much affected by weight and bulk. When the tendency is to increase the weight and bulk of ordnance, of ammunition, stores, and everything connected therewith, and when we have a mountainous country, torrents, bad roads, in an enemy's country and at a distance from the base of operations, these ordinary difficulties must be seriously aggravated. In following the windings of a mountain stream, or the sharp turnings of a mule-track round the slopes and defiles of hilly countries, it might be beneficial to have gun-carriages and traversing platforms which will turn and move in any direction on their own wheels in very limited space, with ease, rapidity, and without danger of upsetting. Thus turning in their own length, they might defend a prominent position from attack in any direction, by an all-round fire at a moment's notice.

The double-pivot movement of guns can be made applicable to railway traffic, and allows an all-round fire to be used in any available railway cutting, embankment, or any other “coign of vantage.” The ready transport arrangement of the traversing wheel is at once available on a tramway, and the gun can be brought into action whenever and wherever required. Guide plates, introduced on the inside of the wheels of the turn-table pivots, are a decided improvement in giving greater freedom of movement than can be obtained by the flanged wheels, and ensure far greater safety, by giving a greater steadying tendency.

In view of the necessity of maintaining so many colonies scattered

over various parts of the world, and recognizing that our small number of disposable combatants must undoubtedly involve the necessity of the regular forces being supplemented by large contingents of the Naval Brigade, it must be a matter of no trivial importance to be able to equip the latter rapidly, so as to despatch them promptly to the scene of action. This may be secured by assimilating the ordnance, ammunition stores, and drill of every branch of the united services, thereby facilitating co-operation, increasing capabilities and efficiency, and lessening the difficulties of transport by having uniformity in arrangements of transit and conveyance of packages.

For land service requirements, with a large traversing platform or slide, having increased inclination, that is, with greater height in rear and tapered to a point in front, the mounting and dismounting of both gun and carriage would be much facilitated, the carriage could be slid off in front when the traversing platform was turned round to clear the parapet. For mounting the gun on and dismounting it off its carriage, the carriage could be placed end-on at the rear or high end of the traversing platform, for the gun to slide on its trunnions, and be drawn up or down the traversing platform, with the gun-tackles. These (when a powerful purchase is required for heavy guns) can be led to a leading snatch-block, or to a steam or hydraulic capstan, winch, or ram. It has been stated that these arrangements are not sufficiently strong to withstand the severe shock of the recoil of the gun, also that the advantages of circular motion can be equally obtained by the present arrangements of the ordinary land service traversing platforms when working on the C and D pivots. These misapprehensions are made clearly visible by the models themselves in their various but combined applications of all the various A, B, C, D, E, and F, or front and rear pivots, all in one and United Service pattern, suitable for any movement required in any prominent position, where, in addition to all the present available arrangements of port-training bars, breeching, eccentric axles, scotching wedges, stop handspikes, &c., other ample provisions of superior forces can be supplied to check any recoil in any position at a moment's notice. These are too numerous to mention here, and as the C and D pivots are here actually combined with the advantages of both, and can also be individually combined with any other, the B and E in similar combinations giving increased facilities for meeting any required circular, angular, parallel, or elliptical movement. It may be considered by many that the C and D pivots in traversing platforms are sufficient to give a half or all-round fire, yet it cannot be denied that these combined movements must prove far more easy in action, greater in stability, and therefore beyond all doubt more useful.

Preference for the single C and D pivot motion has been proved to be a fine-weather theory, as garrison guns on traversing platforms, fitted to move on these imaginary centres, are expected to turn round smoothly, following circular curves by a succession of flat tangents from straight-lined wheels with double flanges, which with inclement weather are very apt to get out of order, and gag and stick fast, especially when the tackles do not lead fairly, and when the

cross-lifting of the handspike jams the flanges of the wheels against the racers on both sides. With the double pivot movement, however, a real double compound C and D pivot action is obtained, which is more convenient than either of the single ones. Thus, with a front central, or C pivot on a straight line, perpendicular to the front, and a real moving D pivot on another straight line at right angles to it, each of these moving and revolving pivots runs smoothly along its straight line with slight friction, instead of over longer curves with greater friction, and the outer end of the traversing platform and gun sweep round a curve that would correspond with one drawn round both faces of a salient angle of a bastion of 60° for a half-round fire of 180° . In continuing this movement past the right and left flanks of the base of the salient, the movement is reversed, the C pivot passes along the same straight line in front of the D pivot, and the outer end of the traversing platform and gun sweeps round the sides of an obtuse angle of 120° giving a half-round fire of 180° on a flatter segment of a larger circle, and in succession, all round an elliptical curve for an all-round fire. The whole action of this all-round turn is contained in a lozenge or diamond-shaped space of straight lines, either enclosing or enclosed by the curve of an ellipse or oval (whose minor axis corresponds with the length of the traversing platform), and whose half minor axis corresponds with the distance of the front C, and the half major axis with the distance of the D or rear pivot from the front of the slide, and *pari passu*, any other combinations of front and rear pivots form elliptical circuits of half minor and major axis in the same proportion to the distances of the front and rear pivots, from the front of the slide or traversing platform. With the movement of C and D pivots, the straight marginal lines correspond exactly with what in French fortification is termed the "trapeze aplatti," or flattened square, the very acme of perfection for an advanced field work, on the principle of an artillery pit (an extended rifle pit), with ready-made traverse and épaulement formed by the faces of a barbette half-sunken battery parapet.

Rapidity of movement seems to be the chief essential of modern warfare; hence the necessity for compactness and simplicity in every detail. Saving of time, space, and labour, and the utmost reduction of weight and bulk must be sound mechanical economy. An example of this is an extension of this double pivot-motion applied to the ordinary truck-wheel standing gun-carriages, where neither traversing platforms nor guide lines of racers are required, but where instead of the ordinary two truck wheels at each end of the gun-carriage, four wheels on a turn-rail or turn-table are introduced. The gun-carriage will travel more easily on four wheels than on two, and as these frameworks of wheels and turn-tables move in all directions, the gun-carriage can also be turned easily, promptly, and in small space; and if the wheels can be thrown out of gear by an eccentric axle and compressor lever, the weight of the gun and carriage can be thrown solidly flat on the platform to absorb the force of the recoil, then the ordinary gun-carriage obtains all the advantages

of the most perfect traversing platform, without its height, weight, bulk, and expense.

In a central line of revolving guns afloat, or in the broadside arrangement of an over-all direct and oblique flanking fire, also in any polygonal line of fronts, many guns can be concentrated to fire on one point, thus the labour of the Royal Engineer is made trebly effective. For instance, any platform or battery is made available, both for a direct, oblique, or indented battery, and any salient angle ceases to be an undefended one as previously, when duly supported, and by economy of space, a larger number of guns can be mounted, as they can be worked in less space, and by increased efficiency one gun is enabled to do the work of three. Although at first sight an all-round fire does not seem intended to fire through a port or embrasure with great lateral range, or only adapted for a direct fire through a port-hole on one point only, a traversing platform and gun on revolving pivots on wheels that will readily turn, and move easily, in any direction whatever, will also be available for training or trailing right and left through a small port-hole or embrasure, to any angle on an A or B pivot in front. On the contrary the moving pivots can be used either as standing or moving pivots; hence a traversing platform or slide can revolve either on a front A or a rear F pivot, and thus on a rear pivot can sweep round a complete circlet of ports in front, and at each port in succession can be disengaged from the rear pivot and move on a front one with or without port-training bars or breeching gear, but with this additional advantage, that the pivots take the shortest straight line in any direction on a fair lead. In order to meet the requirements both of an end-on and a broadside fire, guns can be placed as in accompanying models of Her Majesty's ships "Iris" or "Mercury's" poop and forecastle decks, by my arrangement on the front corners of a poop-deck and on the after side corners of a topgallant-forecastle, to fire fore and aft as well as on the broadside. The gun firing forward, even under the bowsprit, would at once check the approach of any boat with a cross fire. In monitors or turret vessels all the labour of turning round a circular turret with guns can be dispensed with by using an oval turret with a single gun in barbette, as shown in the oval model presented to the Institution, and as proposed by Admiral Popoff, of the Russian Navy, in the "Catherine 2nd," a new edition of the "Livadia;" and for barbette batteries the elevating turn-table platforms are unnecessary, as they can be replaced by simple arrangements for firing on a high level, with extreme depression or extreme elevation, and the gun reverting vertically on double trunnions, as a vertical double pivot motion, in order to have guns turned to the rear to load on a lower level under cover on a balance.

Captain CURTIS: In the reversible guns are there two vents? I hope the lecturer will be kind enough to leave the models for a fortnight or three weeks, because many of the members might be glad to examine them more minutely.

Captain BEDFORD PIM, R.N.: I feel that I ought to start the discussion, at all events, because I know that so long as twenty years ago on the Tyne, Mr. Fawcus was famous for his ingenuity. One invention in which I felt he would have done great service for the Navy, was the joining together of iron plates. I am sorry that it

was not adopted long ago. You simply slot the plate, and drive through the dovetail rivet ; so close is the joint, that positively I have not been able to detect the junction of the plates at all. That is a simple plan, and much better than that of driving a lot of treenail holes through a plate, and then hanging it on a ship's side ; I must apologize for this digression, but it shows the difficulties inventors have to contend with. I appeal to any gentleman present whether the movement which Mr. Fawcus has explained to-night is not an excellent one, and one you would wish to have on board ship. With this you can point your gun with ease and rapidity in almost any direction. There is one point in the paper I should like to take some exception to ; the proportions of a modern steamship are ten times its breadth to its length. Now while I admire Mr. Fawcus for his patriotism in working year after year, against every odds, as he has done, he must permit me to say, that with a vessel such as the merchant ship he speaks of, and which is of the proportions I have mentioned, it is quite out of the question to carry heavy guns at all, much less to fire them. Of what use for war purposes a vessel 400 x 40 feet can be, I cannot conceive, and I should like him to explain. If you attempt to run out the guns proposed, on the beam of such a ship (and we own them not in tens or hundreds, but in thousands), she must capsize, and if you fire, bang go all the rivets in the wake of the guns. Then these cost certainly not less than 170,000*l.*, for which you could build eight splendid gun-vessels, any one of which could sink your armed merchant steamer with ease and certainty. But with regard to the Fawcus movement on board a gun-vessel, it is all that can be desired, and all I can say is, given the heaviest ironclad ever launched in mid ocean, and let me have the happiness of being on board a gunboat with three brother Officers in command of three other gunboats, and if we do not sink that ironclad, I shall be astonished ; directly she begins to roll, she shows her bottom, and offers a mark you cannot miss. I think that Mr. Fawcus deserves very great credit for coming here to-night from the north country, with those beautiful models, and I beg to suggest, with Captain Curtis, that he will leave them here as long as he can, so that members might work out the principle of the invention for themselves.

Lieut.-Colonel HOPE, F.R.S. : Mr. Fawcus refers to his system, as I understand, in reference to the transfer of guns in mountainous countries. The models on the table appear to be suitable for ships and fortresses, and I cannot see how they can be applied to the ordinary roads of a mountainous country. I should like to have some further explanation on this subject. It seems to me that Mr. Fawcus' system is singularly applicable to standing gun-carriages. Whether it would be superior to the ordinary pivot system for traversing platforms or not, is one of those problems that can only be solved by actual experience ; but anything more cumbersome, more unwieldy, less adapted to guns of precision, than the standing gun-carriage, it is impossible to conceive, and I should like to ask Mr. Fawcus whether the statement I saw in a newspaper some time ago is true, namely, that he offered the Admiralty to fit one of his double-pivot gun-carriages on board the "Castor," at his own expense, leaving it there a certain time for the Officers to experiment upon, and then, if desired, removing it again at his own expense.

Mr. CLEMENT LINWOOD STRONG : I should like to ask how, in that model, in front of the deck, the tackles will be fixed to train the gun, or if he would train the gun by means of handspikes ?

The CHAIRMAN : It strikes me that here is an invention which is going in the right direction, and if the inventor is ready to give his own time and means, with the object of fitting it on board a Government ship on a platform of some kind, it might easily be tried without any great expense. But I am sorry to say that my conviction, derived from many years' experience in the matter, is, that Government officials are required to furnish so many returns at the order of superior bodies, they are required to do so much in a very limited space of time, that they feel overwhelmed with their own work, and are utterly at a loss when anybody comes to ask them to attack a new subject. I believe they look with pleasure at the work of this Institution, as the best mode in which to appeal to the public on subjects belonging to the arts of offence or defence. They say, "If you cannot get a good discussion at the United Service Institution, where the Officers of the two Services are assembled, you cannot get it from us ; but, if you get such a dis-

"cussion, we shall be justified in going to the public for money, and asking for a small addition to the Estimates in order to try this thing, which competent judges believe to promise well." I hope to see some day the proposal of a late very esteemed member of this Institution, Colonel Strange, carried out—that an independent committee should be formed in order to see some of these improvements carried out, which would conduce much to the benefit of the inventor and still more to that of the nation; but it must not be a political committee; it must be chosen just as engineers are chosen for similar purposes from the engineering profession. With reference to the real inclination to investigate, I believe many of our profession would have the necessary knowledge, but you will not find all ready to investigate. Captain Pim spoke of merchant ships that would heel over with the guns, but I believe that with most of the modern guns the ship would not be wide enough to hold them at all. Guns are now getting to be 35 feet long, that is coming very near the beam of the majority of merchant ships. With regard to those peculiar instruments, long known as the trammels for drawing ellipses, I would ask Mr. Fawcus to consider with respect to garrison carriages that one of the commonest things that is thrown about when a battery is in action is gravel or sand, and if these are not cleaned out there would be the same difficulty as is felt with the tramways in our streets. There are bits of shell and various other things that may cause a jam. It is not enough to put a gun on a platform and fire at it from a distance, and then go and sweep the sand, &c., away, but the experiment must be carried on as in the heat of action, when nobody sees how or when a piece of shell or gravel gets in. In a few seconds of time the gun or rail may be injured before there is an opportunity to lock at it. On the existing platforms and racers the trucks do clear them automatically. I am afraid these would not do it. The double movement is, in my opinion, also liable to some objections. Evidently, some of the strains, however accurately the mechanic may make the sliding, must necessarily be thrown on the pivots, and these pivots are quite different in their structure, and size and strength, from those we are accustomed to use; they are too easily distorted and apt to be thrown out of gear. All these are things to be remembered when we are thinking of 80-ton guns and carriages. Captain Albini also proposes to turn the gun over. If he took a gun 35 feet long, weighing 80 tons, and tried to turn it upside down, he would experience more difficulty than with the hydraulic loading. Colonel Moncrieff's method is one which deserves great success, but there are many others that could be used for simple carriages by ordinary artificers on the spot. I have seen in the Navy very rude, simple gun-carriages of trees hewn down on the spot; and we must expect that such things will be done again and again on active service. I think if Mr. Fawcus will now be kind enough to reply to the questions which have been asked, and to give us any further explanation of his models or diagrams, we shall be very much obliged to him.

Mr. FAWCUS in reply said: As to the transport of guns with my carriage in rough country, these wheels (*illustrating*) will turn and move in any direction you like. A question was asked about the tackles, but I think it answers itself. In these models you have the advantage of applying the tackles either on the slide or the traversing platform. In addition to that, you have an opportunity of fixing tackles on to the moving pivot itself, which has the effect of turning the moving pivot in whatever direction you want to go. I have had interviews with the authorities. I asked for a trial, and I even specified that I would do it all at my own cost, that it would not cost the Government one penny, and that they were welcome to submit it to any test they thought fit: and if it succeeded I merely asked them to pay the actual cost, for which I would give the vouchers; and if it did not succeed, would remove everything at my own cost.

The CHAIRMAN: I think it only remains for those present to give the thanks of this Institution to Mr. Fawcus for his coming here from so great a distance. I venture to hope he will be able to leave the models for the inspection of the members of this Institution, as long as he is able to do so without inconvenience to himself.

THE LAWYER'S MARINE POCKET CASE.¹

By CAPTAIN BEDFORD PIM, R.N.

HOWEVER much I may pride myself on the usefulness of the little Case before you, I do not attempt to raise it to the dignity of an invention. Its contents occurred to me as the results of observation in our Law Courts of the want of some such *multum in parvo*, especially in cases like those of the "Bywell Castle" and "Princess Alice;" of the "Forest" and "Avalanche;" the running down of the "Tongue" light ship; H.M.'s cutter "Fanny" and the "Hibernia;" H.M.S. "Bellerophon" and the "Flamstead," or the German steamer "Franconia" and the "Strathclyde," in all of which cases (typical ones) I was either retained as Counsel, or took a deep interest. But it was not until laid on my back by a severe accident that I was able to bring the Case as near perfection as I at least could make it; and I have brought it here to day, in the earnest hope of being useful to my brother seamen, whether of the Royal Navy or Mercantile Marine, for, indeed, in the present day, it is hard to say why these two great Services should not always be coupled together, as combined they are the true mainstay of the empire, whereon its wealth, safety, and strength chiefly depend.

In dealing with the shipping casualties of the present day (to say nothing of their frightful frequency), a great deal more knowledge is required than in former times. When I first went to sea in the Merchant Service, about forty years ago, collisions were of comparatively rare occurrence; they were, moreover, generally of a trifling nature, and certainly not attended with anything like the serious loss of life of those of modern times. In those days the crews were English, now the greater part are foreigners.

I am anxious to dispel a popular error, as to the cause of the numerous collisions which now take place, an error prevalent in very high quarters, viz., that these casualties are attributable to the extraordinary increase in the number of English ships, and consequent overcrowding of our ports and rivers. But in point of fact, the number of our ships is less now than it was twenty years ago.

The figures may be interesting, and therefore I will mention that, in 1865, the amount of British shipping reached its culminating point in nearly 27,000 vessels. At the present moment, the number is about 22,000, although it is quite true that British *tonnage* has largely increased.

To give an idea of the frightful frequency of shipping casualties, let me tell you, that the average, for some years, has reached between two and three thousand per annum, that is to say, that since the time

¹ Taken as read at the Meeting on Friday, June 17th.

I mentioned, forty years ago, when a collision was a comparatively rare occurrence, we have now to lament that at least five vessels daily come to grief, whilst in the Mercantile Marine some 3,000 lives are lost yearly by drowning alone.

You will therefore see, that there is, alas! abundant opportunity for testing the usefulness of my Case, and I hope by its use to enable our Courts to arrive at the true reason of the loss or casualty, and thus to bring about in time the application of effective remedies to prevent the present deplorable state of things.

I will now call your attention to a few of the leading points or features in the contents of the Case, and first in respect to the models.

It must be obvious, I think, to everyone, how important (I might say all-important) it is to illustrate as graphically as possible the leading features of a collision. Now no word painting can convey to the judge and jury the idea of the situation so clearly as by means of models. It is true that wooden blocks shaped at both ends have long been used at the trials of shipping casualties; but those blocks, supposed to represent ships, were always of the same size, and therefore quite failed to convey the right impression, whenever the vessels colliding were of different sizes. It will be observed that these models can be readily taken to pieces and joined at any ordinary dimensions. Suppose, for example, the case of the "Hibernia" and H.M.'s cutter "Fanny." Here you have a vessel four times her beam for length. All that has to be done is to unship the model you intend to represent the "Fanny" and join the two parts marked 2. You will notice that each joint has the number of its length underneath. The model representing the "Hibernia" need not be disturbed, because it is of the same proportions as that ship. A glance at the models placed in the position of contact gives a good idea of the situation.

In respect to the compasses, you will see that they are made to answer a double purpose, viz., as compasses to measure distance with one end, as callipers to take the thickness of a plank or iron plate with the other; in the case of iron ships, this latter measurement is often of great importance.

The protractor, as everyone knows, is very useful to lay off the course, or to fix the position by cross-bearings. I have added a scale at foot, and I have had the whole printed on thick paper so as to reduce the cost to a minimum.

On the principle that "trifles make the sum of human things," my pencils are made green and red, to match a ship's lights, and can thus show by a stroke of the pencil whether the ship was going to port or starboard by means of the colour, also her course is thus kept in the memory of those concerned.

I now come to a few points in the blue book, the "Aid to Memory." There will be found in this little work many useful hints! Most shipping cases turn, I think, on obtaining from the witnesses exact information with regard to lights, distance, sound,—and on each of these points I have called attention to very

simple facts; such, for example, that under no circumstances can the present green lights be seen beyond two miles, consequently, whenever a green light is reported, not a moment should be lost in directing the course to be steered: and if this is not done, we know pretty well whom to blame.

The question of distance I have always found a "burning" one in collision cases. I have therefore worked out tables, by which, given the ship's speed and the time from sighting, the distance traversed can be seen at a glance at page 15. For example, a knot is 2,028 yards; if a ship is going ten knots an hour, she will cover very nearly 340 yards in one minute, say three times the length of an ordinary passenger steamer of the present day.

Regarding sound, I need only allude to the facility with which an accurate measurement of distance can be obtained from the knowledge we possess of the rate at which sound travels; in fact, in H.M.'s Surveying Service, and elsewhere, I have often been dependent for a base measured entirely by sound, calculated by the time between seeing the flash of a gun and hearing the report.

Altogether, I think I may say that some useful information will be found in the pages of this little book, and therefore I will not enlarge upon its contents, but venture to beg you to read it. I have had great pleasure in asking the acceptance by the Institution of one of my Cases, which will be found in the library, and may, I trust, prove useful.

In conclusion, I beg to ask those who read these few lines to do me a favour. I am engaged during my little leisure in preparing for publication a "Maritime Cyclopædia," which shall contain every kind of information useful to mariners, and to a maritime population. I am anxious to complete my collection of printed and manuscript matter for this book, and I can only say that any information on subjects even remotely affecting those of our seafaring countrymen whom I have mentioned will be thankfully received.

ERRATUM.

Vol. xxv, page 167, line 8, for "men in close order by men in open order," read "men in *open* order by men in *close* order."

NAMES OF MEMBERS who joined the Institution between the 1st October
and 31st December, 1881.

LIFE MEMBERS.

Miller, Sir C. J. H., Bart., Lieut. Coldstream Guards.	Wilson, R. H. F. W., Lieutenant 10th Hussars.
Sparke, J. G., Captain South Yorkshire Regiment.	Heywood, J. J., Lieut.-Col. Gloucestershire Regiment.
Lillingston, F. G. J., Capt. Kent Art. Mil.	Charrington, Harold, Lieut. R.N.
Middelton, A. H., Lieut. Sutherland and Argyleshire Highlanders.	Baker, W. W., Lieut. R.E.
Granger, H. T., Capt. Liverpool Regt.	Church, E. J., Capt. R.N.
Baxter, C. E., Lieut. R.N.	Gleichen, Count A. E. W., Lieut. Gren. Guards.
Noel, F. C. M., Lieut. R.N.	Appleyard, R. L., Lieut. Royal Fusiliers.
	Hare, T. L., Lieut. Scots Guards.

ANNUAL SUBSCRIBERS.

Kindersley, C. P. W., Lieut. Coldstream Guards.	Harrison, G. E., Lieut. R.N.
Sharman-Crawford, R. G., Lieutenant 16th Lancers.	Stringer, Frederick, Capt. Royal Welsh Regt.
Oswald, Julian, Lieut. 16th Lancers.	White, J. G., Capt. Middx. Regt.
Hejper, A. J., Major R.E.	Allan, A., M.D., Surg.-Major A.M.D.
Swinley, Geo., Lieut.-Col. R.A.	Kay, W. H. F., Paymaster R.N.
Panzer, F. W., Lieut. Antrim Art. Mil.	Byles, M., Com. R.N.
Hall, G. F. King, Lieut. R.N.	Carleton, G. D., Lieut. Leicestershire Regt.
Addison, G. W., Capt. R.E.	Tyrrell, F. H., Lieut.-Col. Madras Inf.
Palmer, G. H., Capt. R.A.	Plomer, W. H. P., Lieut. Royal Irish Fusiliers.
Ferguson, J., Capt. Royal Irish Fusiliers.	Rogers, T. R. B., Paymaster R.N.
Robinson, Henry, C.B., Dep. Controller.	Hope, H. R., Major Madras Cavalry.
Stephen, A. C., C.M.G., Lieut. Royal Lanc. Art. Mil.	Stevens, S. W. O., Colonel late Bo.S.C.
Arbuthnot, R. K., Mid. R.N.	Carpendale, W. M., Lieut. West Yorkshire Regt.
Clerk, H., Lieut. 2nd Dragoon Guards.	Macdonald, G. G., Lieut. Gren. Guards.
Archer-Shee, M., Capt. 4th Batt. Middx. Regt.	Willshire, Sir A. R. T., Bart., Captain Scots Guards.
Anderson, R. D., Lieut. R.A.	Dallas, James, Lieut. R.E.
Brickenden, R. H. L., Captain Royal Highlanders.	Harris, R. H., Capt. R.N.
Lindsay, C. L., Lieut. Grenadier Guards.	Harbord, Hon. C., Lieut. Scots Guards.
Rooper, H. B., Lieut. R.N.	Dawson-Damer, L. G. H. S., Lieut. Scots Guards.
Reeves, John, Capt. North Staffordshire Regt.	Finnie, R. B., Lieut. Scots Guards.
Whalley, F. J., Capt. Liverpool Regt.	Milner, E., Lieut. Scots Guards.
Tottie, J. B. G., Lieut. Durham Art. Mil.	Ashworth, J. A., Lieut. R.N.
Leveson, E. J., Esq. R.N.	Dundas, R., Lieut. Scots Guards.
Wilson, M. W., Lieut. late 11th Hussars.	Darwell, W. E., Com. R.N.
Brereton, F. S., Lieut. late 60th Rifles.	Johnson, R. F., Capt. R.A.
Grogan, E. G., Capt. Royal Highlanders.	Stephenson, T. E., Lieut. Essex Regt.
Jackson, T. S., Capt. R.N.	Sapte, H. L., Lieut. Sussex Regt.
Allatt, H. T. W., Capt. Duke of Cornwall's L.I.	Mallock, T. J. R., Capt. Royal Fus.

OCCASIONAL PAPERS.

This portion of the Number is reserved for Articles, either Original or Compiled, on Professional Subjects connected with Foreign Naval and Military matters; also for Notices of Professional Books, either Foreign or English.

It is requested that communications or books for review may be addressed to Lieut.-Colonel Lonsdale Hale, at the Royal United Service Institution, Whitehall Yard, London, S.W.

THE NEUTRALITY OF SWITZERLAND AND HER DEFENCES.

By Captain N. L. WALFORD, R.A., Instructor R.M. College.

THE Republic of Switzerland has been during the last year rudely awakened from her dream of security, by a cry of warning from many of her citizens, who by their position are entitled to judge, as by their knowledge they are able to measure, the probability and the magnitude of a possible danger to the existence of their country.

The question which has thus aroused public interest in Switzerland turns upon her geographical position with regard to the four Great Powers, France, Germany, Austria, and Italy; and the warnings which have been uttered by her sons refer to the responsibility entailed upon her by that position, especially with regard to her neighbours on the north and west. Meetings have been held, and pamphlets written, to enquire, to consider, and sometimes to foretell, the probable fate of Switzerland in the event of a war in Central or Western Europe; and by the force of circumstances, enquiry and prophecy have been mainly directed to the case of a future war *de la revanche* between France and Germany.

At the re-distribution of the territories of Europe which followed the fall of Napoleon, since no one of the interested States was in a position to venture alone to set its neighbours at defiance, it was agreed to neutralize¹ *la clef militaire de l'Europe*, which all coveted, but none dared to seize; and from this mutual distrust arose anew the Republic of Switzerland, which was at the same time augmented and strengthened, with the avowed object that it should have the power to protect itself from insult.

The existence of the Swiss Republic, as constituted by the Congress of Vienna, is undoubtedly contingent on its non-interference in European wars, and further, on its will and ability to refuse the use of its territory to any belligerent; and many of the Swiss, fully sensible of this fact, and proud of the independence for which in olden days their fathers so bravely fought, call loudly upon their rulers to take such measures as shall ensure the power of their country to preserve her neutrality, since, should she fail in this respect, she is in danger of becoming in turn a military high road, a seat of war, and eventually a dependent province.

But it must not be imagined that on this question the Swiss are by any

¹ Thiers.

means unanimous, for, as in all communities in which the expression of opinion is not repressed by force, every variety of feeling is shown on the subject, and that which one party declares to be a vital necessity, is by the other clearly proved to be a foolish extravagance; while the possibility of invasion, which hangs as a sword of Damocles over some, is to others as vague and impalpable as a summer cloud.

Again, that impatience of a standing army, and that hatred of a military spirit,¹ which seem to lie in the heart of every republic, lead many of the Swiss to dread preparations even for defence, as tending to introduce a more or less open rule of the sword; others draw attention to the poverty of the country, and comparing its slender budget with the vast expenses demanded by modern fortifications, guns and missiles, openly avow their preference for possible future difficulties over certain imminent bankruptcy.

We may dismiss in a few words those who, fearing the severity, speak only of the hopelessness of the struggle, and also those Tells of the nineteenth century, who hold that the Alps are a sufficient source of strength, and who forget that there is a winter in every year, and that the line of perpetual snow, though strong as a defensive position, is not liberal in its supplies of provisions to those who adopt it as their fortress.

The "alarmists," on the other hand, point to the open condition of the frontier, the absence of fortresses in the interior, the limited numbers and the insufficient training of their army, and the small size of their country, and drawing attention to the gigantic armaments of their neighbours, to the immense concentration of fortresses on the east of France, and to the sudden and swift nature of modern war, declare that, unless immediate and strong measures be adopted, Switzerland will be swept away by the next European war like a blade of straw by a mountain torrent.

It is intended to examine in this paper: (I.) Whether the invasion of Switzerland is a probable phase of a future European war; (II.) The measures which have been proposed to avert or resist such an invasion.

The probability of invasion must be determined to a great extent by the advantages which the invading Power would derive from such a course, and it will therefore be well to show from history the use which has been made of the geographical position of Switzerland by its possessors at various times, and further, to suggest in what manner and to what degree its occupation would be desirable to each of the surrounding States, whose relations to each other have been changed since the Congress of Vienna, by the wars of 1859, 1866, and 1870.

I. The probability that an invasion of Switzerland will form a phase of future European war.

(a.) The strategical value of Switzerland.

The importance of Switzerland from a military point of view, and the *raison d'être* of its independence, spring from the very fact which seems most directly to threaten the latter, namely, that it is bounded towards the four cardinal points by Germany, Austria, Italy, and France, and offers by its position, to whichever of these Powers may be sufficiently strong to secure it, an excellent base for offensive military operations against the others. In the event of an alliance between two or more of these Powers, the possession of Switzerland would afford to such allies a subsidiary base and a second line of attack, or under other conditions a point of junction and a means of intercommunication.

¹ A Vaudois newspaper angrily complains that the military authorities of that canton have threatened to set the police upon the tracks of any recruit or soldier who has not fulfilled the obligations of his service, or who is absent without leave!!! And concludes, "Whither are we tending? Slowly but surely to a regular and "permanent army."

It would be impossible in the limits of this paper to examine every combination and eventuality which might arise, but it may be worth while, as examples, to consider two cases of possible alliance. Let us suppose that France and Italy combined declare war against Germany; one glance at the map will show that, given the neutrality of Switzerland, Italy can strike a blow at Germany by only two ways; either she must march her army by a circuitous route through France, or she must transport it by sea to some point on the German coast. The former plan would restrict the allied forces to action against Alsace and Lorraine, while the latter would condemn them to isolated and probably inconsistent action.¹

But on the other hand, if France or Italy can occupy Switzerland, the forces of Germany are compelled to face in two directions, and a blow struck against one of the allies must invite a counter-stroke from the other; to advance for the Germans would be impossible, hesitation would give advantage to the enemy, and retreat would imply the abandonment of the line of the Rhine.

As a second case, let us assume that Germany and Austria, as allies, attack France; if the neutrality of Switzerland be respected, the Austrian Army must either reinforce the already sufficient German forces on the Rhine, or must attempt a landing on some portion of the French coast; but should Austria seize Switzerland, the vulnerable portion of the French frontier is at once increased by 100 miles, the allies are in close communication, and the French Army, unable without undue dissemination of force to cover so immense a front, is of necessity compelled to concentrate towards the west, probably on Paris.

Let us now consider the effect upon each of these Powers, should any of the others occupy either temporarily or permanently the territory of the Republic.

1. Italy. The possession of Switzerland by one of the Great Powers opens out to this nation the possibility of danger along 250 miles of frontier, which space is at present absolutely secure from invasion; and although the mountainous character of the border restricts military operations to the passes, yet of these there is a sufficient number to render a system of defence costly, even if it might be made proof against an invader. As matters at present stand, Germany can strike Italy only from the sea, Austria from the Tyrol, and France from a short and mountainous frontier.

2. Austria. For this Power the possession of Switzerland has lost much of its importance,² for she, since 1866, holds but little of Italy, and having forfeited her rank in Germany, has now no responsibility or share in the fate of that Empire, which, standing as a sentry on the west of Austria, either compels or inclines her to turn her attention principally eastwards. Yet for Austria the neutrality of Switzerland has at least this effect, that it renders impossible any attack from France, except by way of the Adriatic, while, on the other hand, the possession of Switzerland by Italy would give the latter great advantages in the case of any operations against the Tyrol.

3. France. As we have before stated, the possession of Switzerland by any other Power would extend the length of frontier to be defended by France by 100 miles, and would proportionately increase the number of lines by which an invader might advance. But such an increase of the front to be guarded would necessitate a corresponding attenuation of the line, thereby weakening the chain in every part, while a rupture at any point must of necessity lead to the collapse of the whole. Again, Switzerland, so long as it is neutral, acts as an island in a river, and divides the northern from the southern invader, so

¹ In any case the line of communications of the Italian Army would be of an immense length.

² Except in the case of an alliance with one of the three other Powers.

that for an Italian Army to reach Paris is as difficult a task as for a German Army to capture Lyons. It is possibly only on account of their appreciation of these facts that the French have expended so much care and money on the fortifications and communications of the Franco-Swiss frontier, which expense, or rather its result, is the last exciting cause of the Swiss agitation.

4. Germany. The old Rhine frontier between France and Germany ran, roughly speaking, north and south, but the Swiss-German Rhine frontier runs east and west, and at the angle formed by these two lines stands the town of Bâle. The line of the present French frontier and that of the Rhine above Bâle form a re-entering angle as regards France, and, though the latter has lost much of the benefit of this fact by the cession of Alsace and Lorraine, and the consequent loss of the Rhine below Bâle, yet a French Army, concentrated on the Northern frontier of Switzerland, would, by its advance into Germany, turn the line of the Rhine fortresses, and the flank of a German Army posted on that river.

Again, if we assume that it is unlikely that France, unless compelled by political or other circumstances, will commit herself to a new war with Germany, until either the latter is weakened by internal dissensions, or the French can find an ally, how great an advantage would be to her the possession of Switzerland, in the latter case in order to effect a junction with the Army of Italy or Austria, in the former to obtain easy communication with the (supposed) discontented States of South Germany.

But one thing must be remembered, viz., that no powerful State will endure that the neutrality of a smaller State, whose territory if seized by an enemy would facilitate her own invasion, shall be for one moment in doubt; in other words, should Germany have reason to believe that France proposed to use Switzerland as a stepping-stone to Ulm, and that the Swiss were unable or unwilling to defend themselves, would she not reach forth her hand and hold that stone at any cost? and what Germany holds she never loses.

It may be well now to show, by a few examples from history, the use of the geographical position of Switzerland which was made by various belligerents during the Napoleonic wars.

(b.) Examples from history.

In the early part of January, 1798, a French Army, at first under General Menard, and afterwards under General Brune, invaded Switzerland by way of Lausanne: Fribourg and Soleure were carried by assault, and the Swiss line of defence on the Sarine was turned after an attack in front had failed: shortly afterwards Berne capitulated, and, the Swiss Army having dispersed after the murder of their leader d'Erlach, the French took entire possession of the country.

Geneva, Porrentruy, and Bienne were added to France, the Swiss being nominally indemnified by the addition to their Republic of the Grisons and the Valais;¹ in the latter, however, the French reserved to themselves the use of the road through the valley of the Rhone to the Simplon.

Though still nominally independent, Switzerland now in effect became entirely the property of the French, and in 1799 we find that the presence of Massena, in the Rhine valley, with 45,000 men, caused the Archduke Charles to abandon the pursuit of a French Army under Jourdain, which he had defeated at Stokach, and obliged him to turn his attention to Switzerland.

The Austrians, making use of the re-entering angle formed by the frontier, attacked Massena from each end of the Lake of Constance, and drove him back to the Limmat, on which river he took up so strong a position,

¹ Which, as well as Geneva, had been allies, but not an integral part of the Swiss Republic.

that he was left unmolested for three months, during which time he held constant communication with the Army of Italy, by way of the St. Gothard. The Archduke having been recalled to command the Austrian Army in Germany, Massena, taking advantage of the fact that Suwarrow¹ had been delayed by Lecourbe in his passage of the St. Gothard, passed the Limmat and entirely defeated the Austrians, driving them across the Rhine; Soult, on the French right, pushed the enemy from the Linth, and Suwarrow on his arrival found himself obliged to fight his way out of Switzerland by way of Lake Constance, losing in his retreat the whole of his guns and baggage.

The French remained masters of Switzerland, and in the following year (1800) made remarkable use of its position.

An army under Moreau was directed to invade Germany, and at the commencement of the campaign the opposed forces were posted as follows:² French,—Lecourbe, 29,000 men on the Upper Rhine towards Lake Constance. Reserve,—26,000 at Bâle, with an additional force of 30,000 in Switzerland. The main army, 49,000, on the Rhine below Bâle.

The Austrians were at Donaueschingen and Villingen, facing the west, with their left on the Lake of Constance. Moreau marched his left towards his centre, and moved the reserve to the right, pushed his right wing across the Rhine at Stein, and attacked the Austrian left at Stokach (9,000) with a force of 20,000 under Lecourbe, and thus forced the Austrian Army to form front to the south,³ while their base lay to the east in the Bohemian mountains. The battle which ensued was indecisive, but the Austrians were compelled to retire.

Moreau at once sent off 15,000 men under Moncey to the aid of the Army of Italy, and these crossed the Alps by the St. Gothard, while Napoleon moved his army by the St. Bernard. Melas, in the commencement of the year 1800, advancing from his base on the Mincio, had driven back Suchet to the frontier of France and besieged Massena in Genoa. Napoleon, making use of the direction of the Swiss frontier, crossed the Alps by the St. Bernard with 40,000 men, was joined by Moncey at Milan, and, moving on Piacenza, cut the Austrian line of communication.

This attitude, though too late to avert the surrender of Genoa, forced Melas to move eastwards against Napoleon, and Suchet at once attacked the Austrian rear.

The French awaited the enemy at Marengo, and, after a battle at that place, Melas surrendered, and abandoned the country as far as the Mincio. We may also notice that in October of the same year the fact that the French held possession of Switzerland enabled Macdonald to march an army of 15,000 men on Como by way of the Splügen.

In 1803 Napoleon, having no further need of Switzerland for aggressive purposes, allowed it to assume a quasi-independence, and even laid great stress upon his intention to observe its neutrality, while the institution of the Confederation of the Rhine, and the annexation of Italy to the French crown, advanced in later years the strategical frontier of France to such an extent that Switzerland ceased to be of the same value as before as a base for offensive operations.

The next violation of the neutrality of the Republic occurred in 1814, when the Allies, having driven the French Army across the Rhine, determined to invade France.

The Army of Bohemia, under Schwartzenberg, having crossed the Rhine

¹ Advancing with a Russian Army from Italy.

² "The Operations of War." Major-General Sir E. Hamley.

³ The Austrians were thus compelled to form front to a flank; but it must be remembered that a German Army of the present day placed in the same position would still cover its communications.

at and above Bâle, occupied the Jura from that city to Geneva, and made of this line a new base for its operations against Paris; by this movement the line of fortresses on the Rhine frontier was turned, and the heart of the country laid open to the invaders, while, owing to the indecision of the movements of Augerau (who commanded in the south of France), the Austrian General was able to hold him in check with a portion of his force, and to push his main army on Paris through the gap of Belfort, between the Jura and the Vosges. The possession of Geneva by the Austrians threatened also the line of advance of the Army of Italy into the south of France, and this fact must not be overlooked in considering the conditions under which an Italian Army can invade France, either alone or in alliance with another Power.

Since 1815 Switzerland has enjoyed peace, disturbed only by some slight internal commotions, by an embryo quarrel with Prussia in 1856, and by the necessary mobilization of her army in 1870, a measure which resulted in the internment of Bourbaki's force in 1871.

At the commencement of the war of 1870 the neutrality of Switzerland was guaranteed by both France and Germany, but can the Swiss be sure that such a guarantee will again be given; or that, if given, it will be again as scrupulously observed, should the fortune of war tend to make of its violation in a future struggle a more tempting opportunity or a more opportune temptation?

These questions bring us to—

(c.) The possible advantages to be derived, under present conditions, by belligerent Powers from the invasion of Switzerland. The limits of this paper will not permit of the analysis of every possible contingency, and it will therefore be well to consider that only which the Swiss believe to be the most probable and the most dangerous, namely, the case of a war between France and Germany.

Should such a contest arise, the situation will be as follows:—Germany, having in 1871 obtained possession of Alsace and Lorraine, has made of Metz an entrenched camp of sufficient size to contain an army, and in the rear of this formidable outwork holds the passages of the Rhine, with large fortresses at Strasbourg, Germersheim, Mayence, and Cologne, and with smaller ones at Neu Brisach, Rastatt, Coblenz, and Wesel.

On the other hand, France has covered her eastern frontier with an even stronger line of defence, including Mézières, Verdun, Toul, Epinal, and Belfort, with St. Quentin, Rheims, Langres, Besançon, and Dijon in the second line. In addition to these fortresses, and on the lines of communication between them, lie the smaller posts Hirson, Sedan, Montmédy, Longuion, Soissons, Nogent-sur-Seine, Vitry-le-Français, Laon, and La Fère, while along the frontier, groups of forts cover the principal passes of the Vosges and the Jura.¹ And in the centre of this web of obstacles stands Paris with her twenty new forts and her line of defence eighty miles in length.

Those of the Swiss who foretell danger to their country in the event of a war between their neighbours agree that the French, should they at any time assume the offensive against Germany, would recognize the difficulty of either reducing or masking Metz, and of forcing the passage of the Rhine below Bâle, and would therefore rest content, in that portion of the theatre of war, with holding their fortresses on the defensive against the Germans, while their active army would turn the line of the Rhine by way either of Belgium or of Switzerland; and that it is with this view that they have lavished so much money and care on their defensive works and their communications.

But on the other hand, say the opponents of the agitation, how will it be

¹ It is estimated that the French have expended 1,300,000,000 francs on their fortifications.

possible for the French to make such a movement? The position of the Germans at Metz, that knife held to the throat of Paris, will prevent any possibility of such strategy, since of two opposing nations, that which is most directly threatened at its heart must abandon the offensive; and Paris, though hugely strong, is only about 200 miles from Metz, while it is a "far cry" from Bâle or Schaffhausen to Berlin.

But, say the others, Berlin is not the Paris of Germany; if it were, the French would prefer to advance by Belgium, and we should feel more secure. Paris, indeed, must be the objective of a German Army, but that of a French invasion is more likely to lie in the south than in the north of Germany. Again, assuming that such a movement as that which we fear will be impossible at the commencement of the next war, there still remains a possibility which must be taken into account; namely, should the French, after a longer or shorter struggle, succeed in pushing back the German Army to the Rhine, and, having detached a force to contain the garrison of Metz, now left to its own resources, desire to make the passage of the great river, would not France in this case be sorely tempted to seize the advantage which would accrue to her, could she but win her way through Switzerland or Belgium?

In that case, say the objectors, let us watch the signs of the times, and when danger is seen to be at hand, then let us prepare for it.

A blow is seen only as it falls, is the answer. Fortresses and entrenched camps such as may shelter and support an army are not to be built in a day, while small forts are easily overwhelmed in these times of the concentrated fire of long-range guns; again, when cannon were cast, they were often made even during the progress of a siege, but now, in order to provide guns, you must have steam-hammers, steam-planes, and all the extensive "plant" of a manufactory, not to mention those slow-growing products of demand, skilled workmen. And, given that we can buy guns, rifles, and warlike stores, and that we can even construct at short notice a camp or fortress such that it is proof against assault, is our army in such a condition that we can be certain even to mobilize it in time?

There is yet another alternative to be faced. It is possible that France, having failed to inflict such a blow upon Germany as shall force the latter to offer Alsace-Lorraine as the price for relief, may endeavour to indemnify herself for the loss of those provinces, by securing a new Rhine frontier in Switzerland, and Prussia would not improbably prefer, if such a choice were unavoidable, to keep at this cost the entire possession of the Lower Rhine.

The Swiss appear to little anticipate any invasion of their country by the Germans, for the reason that the latter can require no other point of departure than Metz, though it is of course possible that, under certain conditions, a subsidiary line of advance might be desirable. But, as has been mentioned above, the real danger to Switzerland from Germany lies in the desire of the latter to secure herself from attack from the frontier of the former, and the German press has on several occasions more than hinted that, if certain contingencies should arise, it might be necessary, on purely benevolent principles, to occupy Switzerland for the good of the Swiss.

It is therefore possible, some say probable, that in the event of a war between France and Germany, the latter may be inclined to anticipate the occupation of Switzerland by the former, who may herself be strongly tempted by circumstances to turn the German flank by movements which will directly violate the neutrality of Switzerland or Belgium.

Each of these States is, it is true, protected by treaties, but the experience of the last few years has taught us all how little trust is to be placed in diplomatic engagements, when once the pressure which caused them to be entered upon is removed. Where is the Black Sea clause of the Treaty of Paris? How much value has the Treaty of San Stefano? Where is the agreement of the Russians as to the boundaries of their conquests in Central

Asia? And was not the status of Hanover, equally with that of Switzerland and Belgium, settled and fixed by the Congress of Vienna? Switzerland may therefore enquire with anxiety whether she or Belgium is the more likely to be the object of attack. She sees that the latter has a fortress at Antwerp, and an army of 150,000 men as its garrison, that England has a direct interest in the preservation of that country, and she further knows, upon the authority of Von Moltke¹ himself, that a French advance in the direction of Brussels would be made subject to the possibility of a great disaster, and without any counterbalancing probability of success. On the other hand, on examining her own resources, she finds a militia of about 200,000 men, of whom 90,000 are almost untrained, while she hardly has any fortifications, but few guns, and no proved leaders of experience in war. No State has an interest in her existence; the German and the French frontiers are both easy of passage; she offers a direct road to what she considers to be the probable objective of a French Army (the rich provinces of South Germany), and she sees that, to crown all, France is daily strengthening her hold on the Jura, to which new lines of railway are being pushed forward, while Besançon has been made a huge *dépôt* of transport. Switzerland knows also, from hard experience, what her fate will be should the two opponents struggle on her soil for her possession, and what she must suffer should her land, as in 1799, become a battle-field for strangers, and the scene of a contest of which she cannot but fear the end. This end, she anticipates, will be either the absorption of the whole country by the victor, or, should neither State obtain a permanent advantage, its division between the combatants, according to the geographical or ethnological boundaries of her various cantons, which already contain many elements of insecurity in their differences of language, religion, and temperament.²

Of the opinion of the German press a few words have already been said. The French military press reproduces the Swiss arguments on the subject of an invasion with but little comment, claims that the fortifications on the Jura are, in the nature of such things, strictly defences, and warns Switzerland against German aggression; but it is noteworthy that neither one press nor the other declares or suggests any certainty that in a renewed war Switzerland will be, as in 1870, guaranteed inviolable in her neutrality.

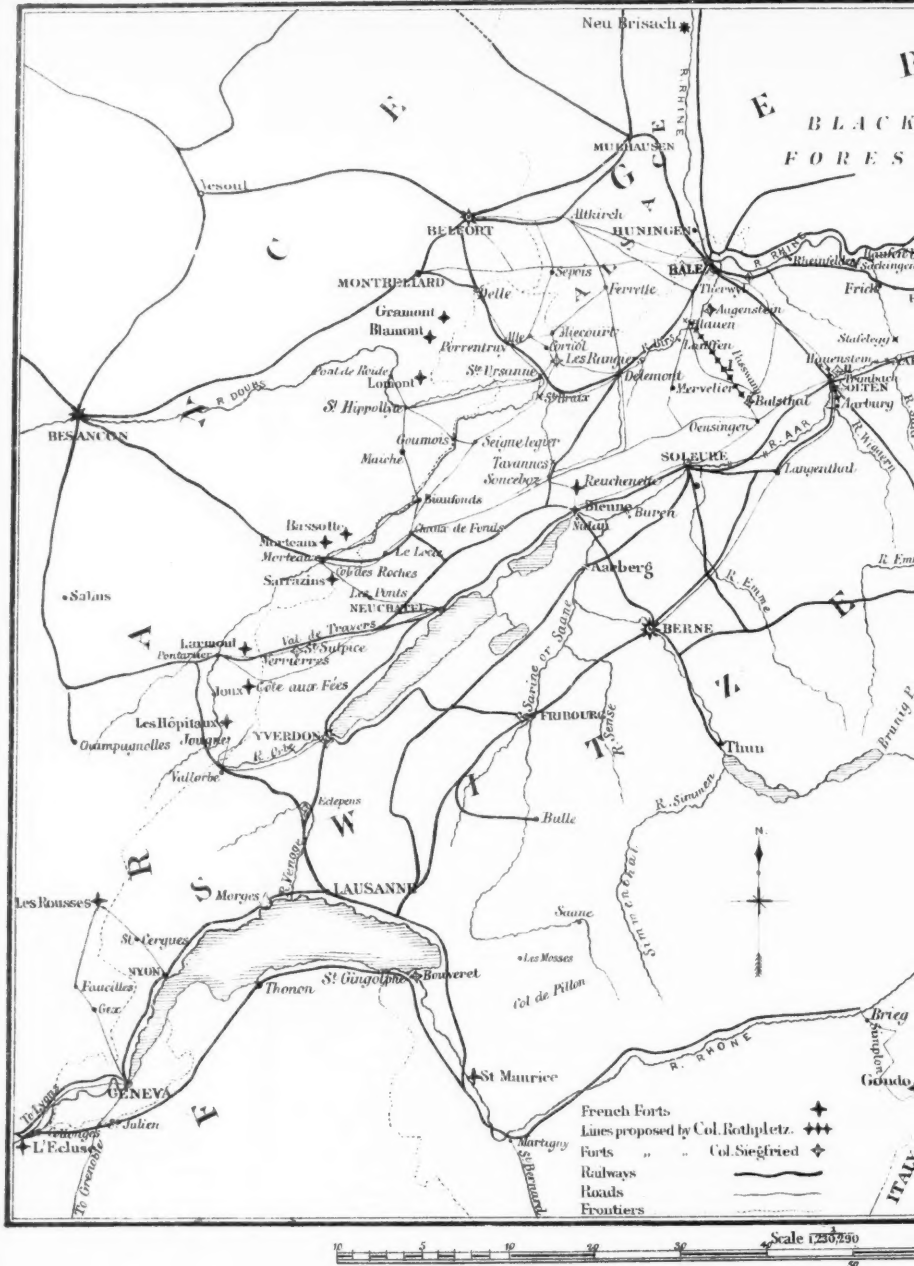
A legitimate deduction from what has been said seems to be that it is possible (under certain contingencies very probable) that the territory of Switzerland may be occupied by one or other army in the event of a war between France and Germany. The consequences, both to the independence and, as will be later shown, to the financial prosperity of the country, of such an occupation would probably be of so stupendous a character that no expense or trouble should be spared to make such an invasion, now a temptation, an act of simple madness on the part of the intruder: and that to this end it is the duty of the rulers of the country to appoint, and for the inhabitants to endure, such burdens as may enable the former to improve the resources they have, to create the defences they need, and to raise their State from its present condition of military helplessness into a firm attitude of national defence. We now pass to the second part of this paper.

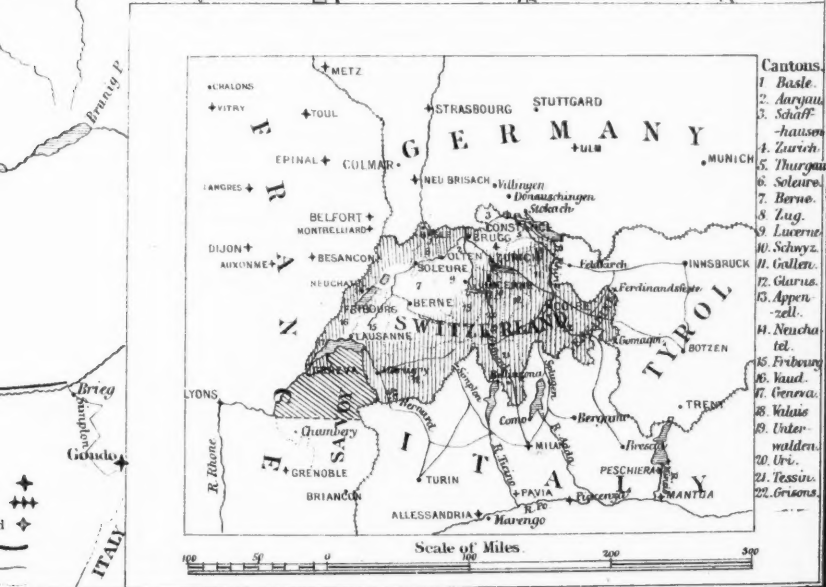
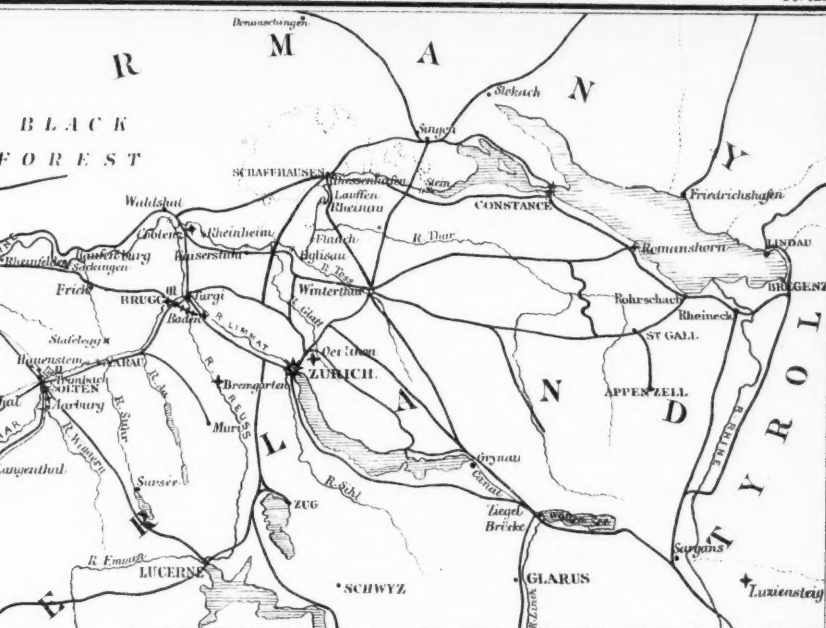
II. The measures which have been proposed to avert or resist an invasion of Switzerland. In order rightly to appreciate these measures, it will be well to describe the military system of Switzerland, and also the character of the country, and from these to deduce a conclusion as to the best general tendency of Swiss resistance.

(a.) The military system of Switzerland.

¹ *Mémoire* before the War of 1870.

² Of the population of Switzerland 70·2 per cent. speak German, 23·6 French, 5·5 Italian, and 1·7 Romansch; while 58·5 per cent. are Protestants, and 41·1 Roman Catholics.





1. Basle.
2. Aargau.
3. Schaff-
4. Thurgau
5. Zurich.
6. Soleure.
7. Berne.
8. Zug.
9. Lucerne.
10. Schwyz.
11. Glarus.
12. Appen-
13. zell.
14. Neucha-
15. tel.
16. Fribourg.
17. Vaud.
18. Geneva.
19. Valais.
20. Unter-
21. walden.
22. Grisons.

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The Swiss Republic has no standing army, but entrusts its defence to a militia, which is divided into two forces, the "Auszug" or "Elite" and the "Landwehr."

Every Swiss is liable to military service at the age of twenty, and is called upon to serve for twenty-four years, of which twelve are spent in the "Auszug" and Reserve, and twelve in the "Landwehr."

The former is organized in eight divisions, contains about 110,000 men, and receives an annual training of from eight to fourteen days; while the latter, amounting to about 90,000 men, appears to be at present entirely untrained, except for so much as its members can retain of their former instruction.

It is further stated that the Swiss forces would require fourteen days for mobilization, of which ten are necessary before the concentration of the divisions can commence.

The Swiss Army is thus not only numerically weak as compared with the legions of its neighbours, but is further inferior to an equal numerical force of French or Germans in training, in discipline, in power of manœuvring, in the use of its arms, and possibly in rapidity of mobilization, failing thus comparatively in everything which distinguishes an army from a mob of patriots.

(b.) The resources of Switzerland.

The revenue of Switzerland in 1879 was 1,622,600*l.*, while its expenditure amounted to 1,681,120*l.*, showing a deficit of 58,520*l.* on the year's account; but her people appear to be, as are most others, strongly averse to any increase of taxation, even though the results of such an increase are to be applied to that which is practically an insurance of their lives, their land, their wealth, and their independence.

How far such an insurance is advisable may be shown by the fact that, omitting the question of loss of life,¹ the occupation of Switzerland by the French, from 1799 to 1803, cost her the sum of 1,500,000,000 francs, while the author of one of the pamphlets on this subject² reckons the probable cost of a war, which should last only two months, at 130,000,000 francs. The expense of a system of fortification which, if it does not (as is hoped) avert the necessity for war, may at least prevent the entire occupation of the country, is variously estimated at from 12,000,000 to 60,000,000 francs.

In what way it is proposed to raise this sum will be considered further on; but one thing is certain, that this charge may be spread over several years, and may be levied in such a manner as may best serve to lighten the public burden, whereas a contribution extorted by an enemy would be collected by such machinery and at such a time as might best suit *his* convenience.

(c.) The general character of Switzerland.

The Swiss divide their country into the "Hochgebirge" and the "Hoch-ebene," which we may perhaps be allowed to translate as "the mountains" and the "plain,"³ and it is on this division that all their systems of defence are founded.

Switzerland is bounded on the west by the Jura range, which extends from Geneva to Bâle, and has an average height of about 4,000 feet above the sea. It is from 15 to 20 miles in width, and is so far an obstacle to the march of an army, that it is with difficulty passable except by the roads; its eastern edge may be roughly defined by the line Lausanne-Yverdon-Bienne.

The south and east of Switzerland are occupied by the various chains and groups of mountains which form the Alps. These, which attain their greatest height on the southern frontier, are during a great part of the year impassable to an army, while they are at all times unsuited to great military operations.

¹ 3,000 inhabitants perished in six cantons alone during the year 1799.

² "Betrachtungen über de Militärische Lage unseres Vaterlandes." Dr. Wagner.

³ Literally "table-land."

Between these two mountainous districts lies the "Hochebene," the "plain" of Switzerland,¹ which extends from Lausanne to Constance (about 140 miles), and has an average width of about 30 miles. It is watered by the Aar, the Limmat, and the Reuss, with their tributaries, and these three rivers uniting at Brugg, thence flow into the Rhine.

This plain is abundantly supplied with roads and railroads; it contains half the population and more than half the wealth of Switzerland; here is the seat of Government; here are the arsenals, the manufactories, and the true commercial life of the country; here is the real strength, the heart of Switzerland; and this plain is the natural highway for an army moving from France to the Rhine, or from Germany on the Jura.

The problem of the defence of Switzerland may then be considered, as far as regards France and Germany, as identical with the question of the defence of the "plain;" for, though incidental combats may extend into the Jura or the Alps, yet the possessor of the "plain" must be the *de facto* ruler of the entire country.

Again, it is evident that the accidental and temporary possession of the "plain" will not suffice to an invader, who needs it as a link in his chain of communication, or as a position for his magazines and dépôts; on the contrary, he must occupy it in comparative peace, and this result can be obtained only by pressing back the defenders into the Alps, and barring by detachments and forts the exits and sallyports of that natural citadel.

(d.) The character of the several frontiers of Switzerland.

(i.) *The French frontier* extends from Delle to Geneva along the line of the Jura, and is crossed by six lines of rail and by thirteen roads; these are covered on the part of France by eleven forts, in rear of which stand the fortresses of Belfort and Besançon.

Roads and Railroads.		Covered by
Railroad.	Delle to Porrentruy.	} Fort Gramont. " Blamont. " Lomont.
Roads.	Delle-Porrentruy-Ste. Ursanne.	
	Pont de Roide-Ste. Ursanne.	
	St. Hippolyte-Goumois-Seignelégier.	
	Maiche-Biaufonds-Chaux de fonds.	} Fort Bassotte. " Morteaux. " Sarrazins.
Railroad.	Morteaux-Le Locle.	
Roads.	Morteaux-Col des Roches-Le Locle.	
	Morteaux-Les Ponts.	
Railroads.	Pontarlier-Neuchâtel.	} Fort Larmont " Joux. " des Hôpitaux.
	Pontarlier-Jougne-Lausanne.	
Roads.	Pontarlier-Verrières.	
	Pontarlier-Côte aux Fées.	
	Jougne-Vallorbe.	} Fort Les Rousses. Fort de l'Ecluse.
Roads.	Les Rousses-St. Cerques-Nyon.	
	Les Rousses-Fancille-Gex-Geneva.	
Railroad.	Lyons-Geneva.	
Road.	Fort de l'Ecluse-Geneva.	
Railroad.	Collonges-Thonon-St. Gingolphe.	
Road.	Grenoble-Chambéry-Geneva.	

The line from Collonges to St. Gingolphe joins at the latter place the Rhine Valley Railway, of which the terminus is at present at Brieg, at the foot of the Simplon; it thus gives a direct communication with Italy.

The above railway to St. Gingolphe, as also the road from Grenoble to Geneva, runs through Savoy, which was ceded to France in 1860; and it is

¹ In the small map the "Hochgebirge" and the Jura are shaded with vertical lines, while the "Hochebene" is left plain.

worthy of notice that this portion¹ of the former country should, under the provisions of the Treaty of Vienna, be neutralized and handed over to Swiss protection in case of war. This obligation was, together with the possession of Savoy, transferred by the Sardinians to the French, and, though the latter have not as yet erected any forts on the territory, it remains to be seen how far they will conform to the Treaty, which, after the fashion of other nations, they are but too anxious to disregard as being out of date.

On her western frontier Switzerland has no defensive works, and the way is therefore open along the entire line to an advance of the French, who, according to one writer,² have the power to mass 200,000 men between Schaffhausen and Constance in six days.

(ii.) *The German frontier* extends from Sepois to Bâle (25 miles), and thence up the Rhine and along the north shore of Lake Constance,³ as far as the mouth of the Upper Rhine.

Across the frontier of Alsace there are—

Railroad, Mulhausen-Bâle, and five roads, viz. :—

Belfort-Bâle.

Altkirch-Therwyl-Mervelier.

Altkirch-Ferrette-Dolémont.

Ferrette-Miécourt-Les Rangiers.

Sepois-Alle-Cornol.

The Rhine from Bâle to Constance is crossed by nineteen bridges, of which three are constructed of stone, five of iron, and eleven of wood, while four of the iron bridges carry a line of rail.

Bridges.

Names.	Stone.	Iron.	Wood.	Remarks.
Bâle	1	1		} Good points of passage ⁴ from the left to right bank.
Rheinfelden .....	..	..	1
Säckingen .....	..	..	1
Lauffenburg .....	..	..	1
Waldshut .....	..	1	..
Rheinheim	1	} Good point of passage ⁴ from right to left bank.
Kaiserstuhl .....	..	..	1
Eglisau	1	} Not a railway bridge.
Flaack .....	..	1	..
Rheinau	1	} Good point of passage from right to left bank.
Laufen .....	..	1	..
Schaffhausen	1	..	1	
Diessenhofen .....	..	..	1
Stein	1	1	} A little lower down the river is a good point of passage from right to left bank.
Constance	1	..	1	
	3	5	11	= 19.

¹ Shaded with diagonal lines on the small map.

² "Les Fortifications en Suisse."

³ The city of Constance, on the south side of the lake, belongs to the Grand Duchy of Baden.

⁴ From a tactical point of view.

The Rhine between Schaffhausen and Bâle is exceedingly rapid, and the construction of a floating bridge at any point between these two towns would therefore be a work of great difficulty.

Two other facts remain to be noted, namely, that the upper passages of the Rhine are alone of use to the French, since, even should they succeed in crossing the river at Bâle, they could gain little by the movement, as their advance would then be limited to the roads of the Black Forest; that the Germans, on the other hand, do not need in their advance to cross the Rhine above Bâle, since by the bridge at Huningen they can move directly on Belfort, should they desire to turn the line of the Vosges and Jura.

Germany has no fortress on this frontier, the nearest are Neu Brisach and Ulm; Switzerland also has no defences, except an old fort (*Annoth*) at Schaffhausen. The Rhine has a width at Bâle of about 200, at Schaffhausen of about 120 yards.

(iii.) *The Austrian frontier* extends to the south of Lake Constance, following the line of the Rhine, and passing round the north-east angle of the Grisons.

One railroad only, that from Bregenz, crosses the frontier, and there are but three main roads, viz. :—

From Zurich to Botzen or Innspruck.

From Constance by St. Gall to Feldkirch.

From Constance by Rheineck and Bregenz.

A Swiss fort at Luziensteig bars the entrance from the Tyrol, and a force stationed at Rheineck could forbid the use of the railway to an enemy.

Austria has two forts on the frontier, Ferdinandsfeste and Gomagoi, which close, the former the valley of the Inn, the latter the Stelvio Pass.

(iv.) *The Italian frontier* is formed by the High Alps, and is at present crossed by no line of rail, though the tunnel under the St. Gothard Pass is now nearly completed.

The principal passes are :—

1. The Simplon.—From Berne or Geneva to Turin or Milan.

2. The St. Gothard.—From Lucerne or Zurich to Milan.

3. The Splügen.—From Zurich or Constance to Bergamo and Milan.

4. The Engadine.—

5. From Zurich or Constance to Brescia by the Cols d'Albula, Bermia, and d'Aprica.

To protect this frontier the Swiss have a fort at Gondo to cover the Simplon, another at St. Maurice in the Rhone valley, and some works at Bellinzona; while the Italians, though holding no points on the border, have in rear the fortresses of Milan and Pavia.

It will be seen by the preceding list of passes that Italy can communicate with France by the Simplon (in addition to Mont Cenis, &c.), and with Germany by the four remaining routes.

It is unnecessary to discuss in the present paper the precautions which are required to prevent the invasion of Switzerland by Austria or Italy, both because the resistance to such an attack would be greatly facilitated by the mountainous nature of the frontier, and also because the attention of the Swiss is more particularly directed towards their northern and western boundaries, which are at once the most open and the most threatened. The heart of Switzerland, the plain, is guarded on the east and south by a cuirass of mountains, and the few and generally difficult passes which traverse this barrier may be efficiently guarded with but a small expenditure of money and men; behind the barrier mobilization and concentration may be easily carried out when every pass becomes a Schipka, and, given these advantages, any invasion becomes at once improbable, since the conquest of Switzerland by Austria or Italy scarcely comes within the scope of practical politics, while the maintenance by either of these Powers of a high-road or line of communications across her soil may easily be made a military impossibility.

But with regard to France and Germany the outlook is very different ; an invasion by either Power (given that it is at present unlikely) may, under certain circumstances, become probable, and is always possible ; and such an invasion is neither obviated nor delayed by any natural barrier of importance, while its advance, which is sure to follow the lines of the rivers, roads, and railways, leads it at once into the centre of the life of Switzerland, dividing the country, checking the mobilization, entirely preventing the concentration of her army, and seizing the seat of Government, the principal arsenals, manufactories, and all the sources of Swiss wealth ; and the same causes which make such an attack deadly render defence against it both difficult and costly.

The Swiss Army, brave as its individual members may be, and skilled as some no doubt are in the theory of war, is very unlikely, by the conditions of its existence, to be ready or fit to take the field on a sudden alarm, and, even were it so ready and fit, it could not expect to struggle successfully against the advance of a trained force of perhaps double its numbers.

Nothing then remains for the Swiss but to take advantage of the only means which exist of equalizing chances in war in the case of disparity in numbers, or in any of the other points by which the value of an army is measured, namely, the resources of Fortification.

But the slenderness of her revenue obliges Switzerland to keep the number and dimensions of her fortresses within modest limits, while the character of her military organization (she having no standing army) makes permanent garrisons impossible. The problem to be resolved is then as follows :—

With a comparatively small and only half-trained army, with a budget which yields at best but a small surplus, with frontiers open to invasion towards two of the Great Military Powers, how is Switzerland in the shortest possible time, at the least possible expense, to render herself secure from attack ?

It may be well to study the systems which have been suggested by various Officers of the Swiss Army :—

(i.) That proposed by Colonel Rothpletz.¹ The original scheme suggested by this Officer included the defence of the entire country, but we need refer only to his plans for closing the western and northern frontiers to an invader. He proposed to surround the borders of Switzerland with forts which should command the various roads and passes, to select certain towns in the "plain" for conversion into fortresses, and finally to arrange a system of fortified points of support on the communications between these two lines.

This scheme, complete as it was and admirable in many respects, we need not examine at any length, as it was soon seen to be impracticable, and has been abandoned by its author, both on account of the great expense of building, arming, and repairing so large a number of defensive works, and also because for their garrison about one-half of the Swiss Army would be required, since their number was as follows :—

On the west front.—	Exterior line,	25 forts.
"	Interior	" 16 lines.
On the north front.—	Exterior	" 12 forts.
"	Interior	" 3 lines.

Fortresses in central "plain," nine ; on the frontiers, four ; towns and cities, viz. :—Thun, Berne, Aarberg, Büren-Nidau, Soleure, Olten-Aarburg, Brugg-Baden, Zurich, Canal of the Linth (Grynau, Ziegelbrücke, &c.), and Geneva, Porrentruy, Bâle, and Schaffhausen on the frontier.

This scheme in its entirety required the construction of about 200 entrench-

¹ "Das System der Landesbefestigung."

ments¹ in addition to that of the central fortresses, and it is obvious that a plan on so large a scale could not be carried out unless Switzerland were prepared to abandon her pacific character, and also to multiply her burdens indefinitely.

Fully realizing these facts, Colonel Rothpletz has lately suggested a new plan of defence, in which he proposes to abandon the "cordon" system in favour of a plan which he styles "radial."

This plan is based upon the idea, which appears just, that an invader will attack not with the intention of conquering Switzerland, but with the object of using her as a high-road to his strategical end; and that, therefore, if Switzerland can make such a passage difficult or even slow, she will annihilate any advantage which might otherwise be gained by its use, and will thus not only secure herself from attack, but will even take away from her possible enemies any temptation to violate her neutrality.

He argues further that, since all such lines of advance, at whatever place they may cross the frontier, must of necessity follow the lines of road, railroad, and river along the "plain," any system of lines of defence intended to delay or stop such an advance must extend across the "plain," and be écheloned on each other.

Colonel Rothpletz, in continuation, lays down ten conditions which any line of defence, intended to cover the "plain" from invasion, ought to satisfy, and these give so clearly the gist of the question that, at the risk of increasing too much the length of this paper, they must be stated:—

1. "The line to be preferred must cover directly, against every eventuality of invasion, a large portion of the Swiss 'plain.'"

2. "It must cut at some point the principal lines of operations of any foreign army."

3. "It must be short in order that it may be strong, even though the number of works be limited, and in order not to require too large a permanent garrison."

4. "It must, as must also its principal groups of works, be situated at the points of intersection of the most important natural obstacles."

5. "It must be strongly supported."

6. "It must not be single, *i.e.*, composed of a single line of forts, for if it were, and were broken at only one point, the other works would at once become useless. It must also be constructed on the plan of independent groups of works, which, nevertheless, must be able in case of need to lend each other support."

7. "The line (and this is important) must be correctly traced from the point of view of strategy, that is to say, it must stand on the line where the interests of Switzerland will meet foreign interests, for the former should hold most firmly to that precisely which an invader may most desire to seize. Further, the choice of the line should not be governed by the political considerations of the moment, but should rather be founded upon opinions justified by historical experience and geographical knowledge."

8. "The line must be so placed that one and the same row of forts may suffice simultaneously for various eventualities."

9. "The line must not serve as a simple bolt, but it must be so arranged that, if the Swiss Army is unable for a time to keep the field, the line may be used as an appointed shelter for the whole force."

10. "The construction of such a line must be practicable from a financial point of view."

On these principles Colonel Rothpletz selects the following lines, which, he says, face towards the four cardinal points, and answer all requirements, *viz.*:—

¹ 30 in the mountains, 170 in the "plain."

Ist Line. From Blauen (about 3 miles north-east of Laufen) over the Passwang to Balsthal.

IInd Line. From Hauenstein (about 3 miles north of Olten) through the latter town, and thence along the Aar to Aarburg.

IIId Line. Brügg-Baden, as a central fortress, connected with the three positions, Staffelegg (8 miles north of Aarau), a point near Erlikon (3 miles north of Zurich), and a point near Bremgarten (on the Reuss, 12 miles west of Zurich).

For this system Colonel Rothpletz further claims that, the total length of his proposed lines being about 56 miles, while that of the threatened frontiers is at least 280, the expense of his scheme as compared with any on the "cordon" system must be as 1 to 5.

(ii.) The system proposed by Colonel Siegfried.¹

This Officer examines minutely into the character of the communications which cross the various frontiers, and bases on their number and direction his scheme of defence.

On the western boundary he states there are four distinct lines of invasion, viz. :—

(i.) From Belfort on Porrentruy ; from the latter place obliquely through the Jura, on to the Aar.

(ii.) From Besançon through the Val de Travers to Neuchâtel.

(iii.) From Besançon into the Pays de Vaud, by the Jura, or by Lyons and Geneva.

(iv.) From Savoy on Geneva and the Lower Rhone, and so into the Canton of Vaud.

All these lines converge on Berne, which is also a railway junction and a point of passage across the Aar ; and Berne must therefore be fortified as a *point d'appui* on the south-west to the line of the Aar.

Colonel Siegfried proposes to fortify this city by enclosing it within two defensive lines of forts, which shall extend in a circle round it, crossing the Aar at a distance of about 3 miles above and below Berne.

Having thus decided upon the position of his central fortress, Colonel Siegfried proceeds to examine the above-mentioned lines of invasion.

(i.) From Besançon by Porrentruy on the Aar.

The various roads across the frontier of France meet at Porrentruy, and run through the Pass of Les Rangiers into the Jura ; the mountainous character of this country forces the roads into the valleys, and of these two lead into the valley of the Aar, namely, that of Reuchenette by Bienne, and that of the Balsthal.

These roads Colonel Siegfried proposes to guard by the construction of forts at or in the vicinity of Les Rangiers, Reuchenette, and Balsthal.

(ii.) From Besançon through the Val de Travers on Neuchâtel.

This road, after following the narrow passes of the Jura, arrives at the defensive line formed by the Lake of Neuchâtel, the River Thièle, the Lake of Bienne, and the River Zihl.

Colonel Siegfried proposes to close this line of advance by a fort at St. Sulpice in the defile, with an alternative plan of fortifying a point on the left bank of the Zihl, such as Bienne.

Thus, a central fortress and four forts are considered to be sufficient protection for the northern half of the west front. The southern portion (about 23 miles) between the Lakes of Neuchâtel and Genève cannot, according to Colonel Siegfried, be defended except on the line of the Rivers Venoge and Orbe, and he selects, with this object, the points Morges, Eclepens, and Yverdon, by which the lines of railway may be best covered. These places are to be moderately strengthened by fortifications prepared in time of peace.

¹ " Die Schweizerische Landesbefestigung."

(iv.) From Savoy on Geneva or the Rhone valley.

Colonel Siegfried abandons as impossible any defence of the City of Geneva, since, lying as it does in a position surrounded by French territory, it must, at the very commencement of hostilities, be cut off from the remainder of the Republic, and proposes to guard this section of the front by a fortress in the Rhone valley.

For the position of this fortress he selects Bouveret, at the point where the Rhone enters the Lake of Geneva, and gives the following as the conditions which such a fortress should fulfil:—

(a.) It should close the road and the proposed railroad on the south side of the lake.

(b.) It should cover the roads and railroads leading from the north side of the lake into the Rhone valley.

(c.) And thus cut off the mountains and their passes which lie at the upper part of that valley.

(d.) It should especially observe the roads from Les Mosses and Pillon.

(e.) It should command the navigation of the lake.

(f.) It should replace the weak fort at St. Maurice as the key of the Simplon Pass.

To the above permanent forts and fortresses Colonel Siegfried proposes to add, on the declaration of war, works on the road leading by the Simmenthal from the Saave to the Aar, and on that of Brünig between the Aar and the Reuss, the positions for these works being prepared in time of peace.

Though the Landwehr may supply these forts with garrisons, yet it is to be understood that for their permanent occupation other forces must be available.

On the northern frontier of Switzerland, the Rhine, as before mentioned, serves generally as the boundary, but Eglisau, Schaffhausen, and Stein on the right bank belong to Switzerland, while Constance, on the south of the lake of that name, forms part of the Duchy of Baden.

The River Aar divides this frontier into two parts:—

(a.) The western part should, Colonel Siegfried considers, depend upon Berne as its central fortress, while the extreme western end of the frontier, that between Porrentruy and Bâle, is sufficiently guarded by the dispositions which defend the northern portion of the western frontier. The inner half of this line, viz., from Bâle to Olten, cannot, he holds, be left to the protection of the former town, which lies too near to the frontier, and he therefore proposes to use for this purpose—(i.) A large fort on the plateau near the Haguenaue-Schanze,¹ covering the line of rail Bâle-Olten, and the bridges of the Rhine and the Birs: (ii.) A fort, to cover the railroad to Delémont, in the defile of Augenstein: and (iii.) A fort on the Rütlihardhubel.¹

With these fortifications Colonel Siegfried considers that he will be able to delay or repulse any attack from Alsace, and will in addition give a certain amount of protection to Bâle.

(b.) For the eastern portion Zurich will form the central fortress, and will, it is proposed, be defended with an outer line of forts, which shall crown the heights on either banks of the Limmat, supplemented on the northern side by a fort at Erlikon; the position of the enceinte is not so easy to determine, as it would be difficult to fortify the town itself; Colonel Siegfried therefore proposes to place a species of citadel below the town on the left bank of the Limmat near the outfall of the Sihl, and to construct a *tête-de-pont* on the right bank. Further, one of the outermost forts on the shore of the lake must be sufficiently large to protect an arsenal and a harbour for gunboats.

For the protection of the important railway junction of Olten, Colonel

¹ These points are not marked on any map, and they are probably local names for features of the ground near Bâle. They have been placed in the position which appears to be the most warranted by the original paper on the subject.

Siegfried proposes either a fort on the south-west of Trimbach and on the heights, or a fort with revolving turrets which shall stand in rear of the railway bridge over the Aar.

A fort of the same description should be made at Turgi to cover the passages of the Aar and the Limmat, and this work is to be supplemented by bridge-heads at Brugg and Baden.

At Coblenz there must also be a fort, unless measures are taken to destroy, at the first news of war, the bridge over the Rhine between that place and Waldshut. Colonel Siegfried proposes further to prepare during peace for the erection of works at Eglisau, Schaffhausen, and Stein, and also to make Romanshorn an arsenal and harbour for the Lake of Constance, such as Bouveret would be for the Lake of Geneva.

In considering this scheme of defence it must be remembered that Colonel Siegfried, who has since died, proposed it in 1873 as a part of a general system for the protection of the entire country,¹ and that it has been lately revived under the influence of the present excitement.

The plans, and to some extent the opinions, of two very distinguished Officers have now been given, and it may be well in addition to examine the advantages and disadvantages of various schemes which have been proposed by others, skilled and unskilled. These are summarized by Colonel Meister in a *mémoire* read to a meeting of Swiss Officers at Soleure,² as—

- (i.) The cordon system.
- (ii.) The system of a central fortress.
- (iii.) The system of the fortification of some interior line which is already strong by nature.
- (iv.) The fortification of the frontier combined with some few forts on an interior strategic line.
- (v.) The system of a fortification of the frontier combined with a central fortress.
- (vi.) The system of defending the "plain" by closing at their junctions the principal lines of operation available for foreign armies, and of defending the High Alps by a certain number of forts on the frontier.

To these we may also add the scheme of those who propose to guard Swiss neutrality and Swiss independence with the Swiss Army alone, and it may be well to consider first the consequence of such a plan.

In support of the theory that fortifications are unnecessary, it is urged that the Swiss Army can be so quickly mobilized that any invasion will find it prepared to resist an attack, but no account is taken of a possible irruption of hostile cavalry, which, even if too late to prevent mobilization, must at least delay and obstruct the concentration of the divisions.

Again, the authority of Napoleon is quoted against the absorption of an army into garrisons; but it appears to be overlooked that the garrisons in that case were in Germany, not in France, while the Swiss fortresses in the country will defend the country. And further, the reason of the existence of the art of fortification is to enable the few to do the work of many; and if it can be proved that this condition is not fulfilled, the art of fortification must cease to exist, since it will be no more needed than the art of tattooing.

The disasters of France in 1870 are also attributed by these Officers to the exaggerated number of her fortresses, but such does not appear to be the opinion of the French, for since the war that number has been greatly increased. It may be justly a subject for doubt whether the position of the French Army of the Rhine would have been much improved on the 14th, 16th, and 18th of August, 1870, could the fortress of Metz have been eliminated from the problem by the wave of an enchanter's wand, and no one who

¹ Nothing has been here written of that part of the plan which referred to the east and south frontiers.

² "Revue Militaire Suisse."

has seen the fortifications of Sedan can believe that the fact of that town being fortified in any way influenced the strategy of the French advance, or even the tactics of the battle.

After the condemnation, on these and other grounds, of any system of permanent fortresses, we are next called upon to listen to variations on the old theme of Plevna. But the character of the defence of that place, wearisome as its name has grown owing to constant repetition, seems to be but partially understood; for the defences of Plevna, improvised it may be, were certainly not hasty in the ordinary sense of the word, and the renown which they have gained is due perhaps less to Turkish skill than to Russian blundering. A new Plevna, if it is in any way to rival its original, must like it require so favourable a fortune that it shall be liable to no serious attack until the arrangements for defence have been duly matured; and, though the example of Sebastopol may lead us to imagine such luck possible, the Swiss would be wiser if they did not trust too much to the want of energy or want of skill of their adversary.

Nor can a Plevna, any more than a fortress, be insured from eventual capture, while the former is liable to be carried by a sudden assault, which is not the case with the latter. A panic, a tactical error, even a temporary want of ammunition may cause the abandonment of some essential point in a line of field fortification; but none of these, nor all combined, could enable an enemy to scale an escarp, unless his way had been prepared by artillery.

Without descending into the technical details of magazines, stores, &c., it may safely be asserted that permanent works must from their nature be superior to even the best field works as regards internal arrangement, cover from fire, and security from a *coup-de-main*; and that financial reasons alone can excuse a State which, when its existence may depend upon its power to prolong the struggle, proposes to meet a numerically stronger force of trained soldiers with a body of militia posted in hastily constructed lines of defence, some of which may even be incomplete.

There remains yet another alternative, namely, that the Swiss Army should offer battle to the invader upon ground carefully prepared for defence. Let us grant such favourable conditions as that the Swiss have found time to concentrate their forces and to construct entrenchments of a hasty kind. We may even go further and allow that a first attack, made with too little preparation, has been repulsed; but the attack will be renewed, one flank or the other will be turned, if not to-day then to-morrow, and the ever-increasing numbers of the enemy will ensure success—let us say, in a week. Where is the fortress which will not hold out for one week, and where is the army that can be certain to hold any position for so long?

Is the fate of Switzerland to be risked on the chance of a single battle, in which her militia must be eventually outnumbered by regular troops; and if not on a single battle, where is the second position to be formed? A Russian Army can retreat indefinitely to secure supplies or to organize reinforcements, a French or German Army has sufficient territory to fall back upon, but how is a Swiss Army to recover, since the country is not sufficiently large to allow it to withdraw beyond striking distance from the enemy? It appears likely that after one such battle the remains of the Swiss Army, having no fortresses on which to rally, must fall back into the natural stronghold of the Alps, every exit of which would be at once secured by the invaders, who would thus at their ease move trains, columns, and guns by the most convenient and best roads through the principal towns and along the comparatively level country of the Swiss "plain."

If the Swiss, having no defences upon which to retire in case of defeat, meet the enemy in battle, they play the game of that enemy; for he, to whom every day is of importance, desires above all to bring matters to a climax, and, having previously delayed and obstructed the mobilization of

the Swiss Army by the action of large bodies of cavalry, will as quickly as possible hurry across the frontier such masses of troops as shall make victory equally certain and decisive.

But by any system of defences which is already prepared at the commencement of a war, the mobilization of the Swiss Army is protected, time is gained for its concentration, and defeat, if victory be impossible, need not include disaster.

It is probable that the strongest position which a weak army can take up is such as is tactically defensive but strategically offensive, that is to say, which is so placed that the enemy cannot neglect it, while it is so strong that he is almost certain to be repulsed if he attack it.

Such a position was Plevna, and let the Swiss, if they please, make such another; but let their hasty entrenchments serve merely to connect and aid permanent works armed with heavy guns; let it be garrisoned by the Landwehr (or the Landsturm if necessary), and let the Auszug or Active Army remember above all that a passive defence must ever be futile, and that there should be no rest for the invaders.

If it be granted that some scheme of fortification is absolutely necessary for the security of Switzerland, it remains to examine, under the before-stated heads, the various plans proposed.

(i.) The cordon system.

The principle of this system is to guard every entrance into the country, which is for this purpose to be surrounded by a ring of forts; and the mode in which it is proposed to carry it into execution is, to fortify the principal towns on the frontier, such as Geneva, Bâle, and Schaffhausen, and further to occupy with defensive works the principal strategic lines of advance open to an enemy.

This system recommends itself to the general public, who can from their own experience appreciate the value of a wall around a garden; and, further, by placing the line of defence on the frontier itself, it fulfils the natural desire of every man to keep off the enemy from his own homestead (a wish which, if an attempt were made to gratify in this respect each individual owner, would soon itself afford the fullest proof of its absurdity); but the project has been at once scouted by professional soldiers, and has received the nickname of the "system of the Great Wall of China." The plan is stated to be unpractical for the following reasons:—The frontier is not in all parts capable of defence, and if it were, to attempt so to defend it would necessitate such a dissemination of force, that sufficient numbers could not be available at any one point to resist a serious attack. From this it follows that the chain of defence must somewhere give way, and in that case the rest of the line is worse than useless (as tending to absorb men required elsewhere), and gives no support to a force fighting in the interior. Again, such a plan is enormously expensive, for it requires a maximum number of forts, and the necessary repairs and care-taking in time of peace cannot be easily provided for.

We may conclude then that this system is quite impracticable, at least as regards the entire circuit of the country; but on the south and east frontiers, where the passages are few and the country is difficult, such a defence of the few roads might be not only possible, but the easiest mode of obtaining security from invasion. As an example of the defence of such a position, that by the Russians of the Schipka Pass is the latest in history, and by its success no doubt can remain of the advantage of so defending, for example, the passes of the St. Bernard or St. Gothard.

(ii.) The system of a central fortress.

This form of defence would probably be the cheapest, or at least might be made so, if the works of the fortress be kept within reasonable limits; but such a fortress would very partially cover the mobilization of the army, nor would it, unless supplemented by works at other points, serve in any way to

prevent the occupation by the enemy of the larger portion of the country, since to concentrate the army on the defence of one point is to abandon the remainder.

Again, though such a fortress would serve as a rallying point for the army, and might so preserve the country from conquest, it would not prevent entirely that which the Swiss dread the most, namely, the use of their land by an enemy as a high-road for the invasion of another Power, and, unless its position were well chosen, might possibly not even hinder such an advance.

But it may be assumed that no system would be considered complete which did not provide for the defence of Switzerland some central fortress or fortresses, whether these be placed at a distance from each other, or be combined into a line which shall cut the principal roads by which an enemy can advance. Such fortified points are needed for the protection of magazines, hospitals, &c., as also for *points d'appui* for the army.

This is the system which has obtained in Belgium, where the defence of the country is concentrated on Antwerp, but, without entering at any length into the subject, it may be sufficient to say that the physical character of the two countries is so entirely different, that neither of them can serve as an example for the other.

For the position of this central fortress have been recommended at various times Berne, Lucerne, Sursée, Brugg, and Zurich.

(iii.) The system of the fortification of some interior line which is already strong by nature.

Such a system has, according to Colonel Meister, been frequently suggested; that which he discusses takes as the defensive line that of the Aar and the Limmat, and proposes to hold it with fortifications at Thun, Berne, Aarberg, Soleure, Olten, Brugg, Baden, and Zurich. A front of this kind has more power than a single fortress to protect the frontier, and it also commands the lines of operation in the Rhone valley, in the Rhine valley, and in the Swiss "plain." But a plan of so great extent would be enormously expensive if it were developed as he suggests, and must in practice be reduced either to the defence of a shorter line, or to a system of two or three fortresses covering important strategical points. Berne and Zurich, or Berne and Brugg are proposed by Colonel Meister, but Berne, apart from political reasons and from its prestige as the seat of Government, does not appear altogether suited as a single fortress, or even as one of a pair intended to cut the French line of advance on the Upper Rhine. It certainly would obstruct a march directed from Geneva on Schaffhausen, but if the enemy wished to move from Porrentruy on Olten, a corps of observation on the Aar would enable them to despise Berne and its fortifications. Brugg and Zurich appear to be better suited for their purpose, but in this case there is again the objection that the major portion of the Swiss territory will be abandoned to the enemy.

In this case, as in the others, there are two contingencies to be considered, for the enemy may intend either the entire and permanent conquest of the country, or a temporary possession of the "plain" with a view to the passage of troops, &c., on a further objective.

It is evident that the position of any line or lines of defence must vary according to which of these designs it is intended to check, and therefore, assuming that such a system will be suited to either purpose, it is proposed to discuss their required position in a later portion of the paper.

(iv.) The fortification of the frontier combined with some few forts on an interior strategic line.

This, as Colonel Meister explains, is intended to imply the fortification of the principal strategic points alone on the frontier, supplemented by the preparation for defence of railroad junctions and other important points in the interior.

In order to explain his meaning, Colonel Meister suggests Les Rangiers,

Sonceboz, the line of the Venoge and Bellinzona as some of the points on the frontier which must be chosen, and selects Olten, Bienne, or Bulle as fortified posts on the interior lines. The total number of forts which he demands is fifty-one, of which some, however, need only be prepared in time of peace, to be completed at the commencement of hostilities.

This suggestion is intended to satisfy those who are unwilling to see the line of the frontier abandoned at once to the enemy, while at the same time it offers several rallying points to the army in rear. The frontier forts will no doubt resist sufficiently long to cover the mobilization of the army, but, unless some description of regular force is kept up in order to form their garrisons, how is *their* mobilization to be ensured?

And to cover the movements and concentration of the better trained troops (the *Auszug*) by the use of the Landwehr is surely, to use a hackneyed simile, to put the cart before the horse; while, if the guard of the frontier forts is given to the *Auszug*, the force available for the field will be seriously diminished.

From a financial point of view this scheme is very feasible, since it lends itself better than any other to the principle of the successive construction of the desired works.

(v.) The system of the fortification of the frontier combined with a central fortress. This in many points resembles the preceding system, but has this essential difference, that the army posted on the interior lines will be concentrated on the fortress, instead of being as in the former case disseminated among the various smaller forts.

But, on the other hand, the possession of many important points will be surrendered to the enemy, whose advance, if it is to be delayed, must be interrupted by the attack of the field army at perhaps a considerable distance from its *point d'appui*.

But, and much stress is laid upon this by some Swiss writers, no system of fortification should appear to be directed against any one neighbour, since such a plan might appear as a threat, and call down retribution. Without seeking to decide whether this is a question of real political importance, it is sufficient for us that the Swiss consider it to be so, and that they are therefore likely to prefer a central fortress, which acts as a *réduit* to the defences on all four of their frontiers, to a system of fortified strategical points which must be directed against one or the other.

Colonel Meister points out the extreme difficulty of selecting the position of such a fortress, since if it be placed where it will be of the greatest value as a *réduit*,¹ it will not be able to protect the valley of the Rhone, the line of the Venoge, the section between the Thur and the Rhine, or the line of the Limmat-Linth.

The question of the advantage of this system, financially speaking, depends, he considers, entirely on the relative amounts which may be devoted to the frontier forts and the central fortress, which alone, if it is to be made sufficiently large and strong, will require a considerable sum for its works and armament.

(vi.) The system of defending the "plain" by closing at their junctions the principal lines of operation available for foreign armies, and of defending the High Alps by a certain number of forts on the frontier.

Colonel Meister states that this assumes to be the simplest mode of fortifying the most important part of the country, namely, the "plain," and he might have expressed himself even more warmly with regard to this plan, since it is the first which takes into account the different character of the two fractions of Switzerland and of their frontiers, and states, as is undeniably true, that the system of defence which may be best for the

¹ In the "plain."

"Hochgebirge" is not, and cannot be, identical with that most suited to the "Hochebene."

The argument of Colonel Rothpletz is next stated, namely, that it is sufficient to make the passage over Swiss territory slow or dangerous to an invader, in order to at once destroy any temptation which he may feel to use Switzerland as a road to his objective, and that if this statement be accepted, there is no longer any necessity for forts on the frontier, which will not be threatened so long as a further advance is barred.

The scheme of Colonel Rothpletz¹ is then given in a few words, is finally criticized, and its faults declared to be—

(a.) That it takes no account of the requirements of neutrality, in that it is directed specially against one, or at most two, neighbours. This accusation Colonel Rothpletz would be the first to deny, since he especially claims for his system that it faces in all directions and secures the country from an attack from any or all of the cardinal points.

(b.) That the centre of gravity of the defence is so far eccentric that Geneva and Vaud are abandoned to the enemy. This complaint might have been made by a supporter of "the system of the Great Wall of China," and a glance at the map will be sufficient to show that geographical exigencies must render impossible any defence of Geneva against a French attack, except at the cost of such a division of the forces of the Republic as can lead only to national ruin.

Unpalatable as the fact may be to the Swiss, it is, and must always be, a fact, that if France put forth her hand to seize Geneva, that city, unless the Great Powers intervene, cannot be preserved to Switzerland; and the same may be said of the Canton of Vaud.

He who wishes to save all, runs the risk of losing all, and the temporary abandonment of a weak outwork has often enabled a General to make his *enceinte* impregnable; nor is Colonel Meister quite fair when he speaks of "hazard" as a factor in the question, for, though the "fortune of war" is an expression so hackneyed that it is believed to be true, war is not in the main a lucky or unlucky combination of chances, but, strange as varying phases may seem, is generally found on inquiry to be governed by as regular and as distinct laws as any other art of human invention. Success and failure in war are usually each deserved, and may often be fairly foretold; and it may surely be admitted that the first care of an Officer, who suggests a system of defence for his country, is to abandon all ground which cannot be defended except at a disadvantage, and to concentrate his efforts on essential and favourable points.

(c.) That Brugg is in its position too eccentric with regard to the shape of the country to allow of its being a good point of defence; that it is also a point from which it would be difficult to assume the offensive; that it does not cover Zurich, or the lines of operation on the Rhine, the Lake of Constance, and the Upper Limmat.

(d.) That the system will be expensive.

As it is not the purpose of this paper to defend the scheme of Colonel Rothpletz, it is not proposed to examine into these latter statements, and the consideration of Colonel Meister's address may be closed by stating that he is not in favour of merely preparing during peace the sites and materials for defensive works, and of deferring their execution until the outbreak of war. His objections to this system are, that the armament must certainly be obtained during peace, since Switzerland has no sea-board; that the time available after the mobilization of the army before the actual struggle must be employed in drill, &c., and that neither time nor men can be spared to prepare defences; that any entrenchments which could be made in so short a time would be of

¹ See page 856.

feeble character, and that the construction of closed works would be impossible; that the supply of skilled sappers is not sufficient for the proper supervision of the simultaneous construction of so many works, while the General-in-Chief would be unable to trust to the defence of partially completed works, should he desire to obtain greater freedom of movement for his field army; and, finally, that the actual cost in time of war would be greater than in peace, since, though labour might be cheaper, tools and transport would be far dearer.

In conclusion, Colonel Meister declares that the fortifications of Switzerland must be guided by three rules, viz. :—

I. No system should be adopted which defends only one portion of the frontier.

II. The forts on the periphery must be first considered.

III. Some *points d'appui* must be provided in the interior.

If these three conditions can be satisfied with due regard to military and financial considerations, and if it be possible to proceed at once to the execution of the works, he suggests three further rules for the guidance of those entrusted with the task, namely—

(i.) The extent of the periphery must not be too great.¹

(ii.) The works must not be placed too near to the frontier.¹

(iii.) The fortifications in the interior must not be too much centralized, but must conform to the eccentricity of the strategic lines of Switzerland.

On this lecture the editor of the "*Revue Militaire Suisse*" remarks that the system of fortification recommended by Colonel Meister is as eccentric and as much disseminated as is possible without degeneration into a cordon of forts, and declares that any defence of Switzerland must be considered as the defence of the Republic, and not of each of its component parts; that, therefore, no attempt must be made to guard every point, but that all efforts should be concentrated on the fortification and defence of a central fortress, which should be at once the base and the pivot of operations, and should be covered only by some small forts on the points of the frontier by which the enemy must inevitably attempt to pass.

"Who shall decide when doctors disagree?"

Enough has probably been said to show, both how divided is the present state of public opinion in Switzerland on the subject of fortifications, and also the principal schemes which have been proposed by various Officers in her army; it may be well now to notice a few of the remarks on the subject which have been made by the French and German press.

The "*Journal des Sciences Militaires*" publishes an article² on "The Fortifications in Switzerland," which commences with the statement that it is not proposed to do more than offer a summary of the opinions of Swiss authors and speakers; but a suggestion is given that, were it not for patriotic reasons, much might be said to prove to the Swiss that their anxiety is needless, so far at least as regards any probability of French invasion.

The case is then stated as to the reasons which lead some of the Swiss to consider that their territory may be violated, and these are followed by a geographical sketch of the western and northern frontiers, and of the various strategical lines by which an invasion may advance; then succeeds an account of the Swiss military system, and, finally, a scheme of defence.

Since all the arguments and remarks in this paper are confessedly borrowed from Swiss pamphlets, they have no value as an expression of French opinion, but the conclusion is of greater interest; in this the Swiss are reminded that Germany may perhaps be a source of danger to them, and it is explained that

¹ It is interesting to compare (i) and (ii) with Colonel Meister's previous strictures on the plan of Colonel Rothpletz. See page 864.—*Tr.*

² May, 1881.

it is because of a possible German attack through Switzerland that they (the French) have thought it necessary to hold the Jura in so great strength. "Switzerland," says the "Journal," "is absolutely impotent, as regards her army, her power of mobilization, and the defensive power of her territory, and the Swiss 'plain' is a high road accessible to every one."

If Switzerland fortify this portion of her territory, "the road of invasion will no longer be so easy, and the advance which we (the French) dread will dash itself against an outwork, which, we may hope, will be vigorously defended." "France will gain by this as much as will Switzerland; it is not for us to complain."

The "Revue Militaire de l'Etranger"¹ also has an article on the Swiss defences, but since it contains little but a review of the pamphlet of Colonel Rothpletz, it is not worth while to make any extracts from it.

"L'Armée Française" has a short article, but of the same description, and, indeed, the notices of the French press on the subject of the Swiss defences have been so few, and those few so guarded, that it may not perhaps be rash to hazard a suggestion that they have been officially desired to say little or nothing on the subject; what is perhaps most remarkable is the entire absence of criticism on the schemes which are narrated.

The "Deutsche Heeres Zeitung,"² after a short preface, details the system of Colonel Siegfried, from which it passes without comment to the consideration of other pamphlets, and closes with some comments on the system of defence advocated by Colonel Rothpletz, and of these it is proposed to make a summary.

The "Zeitung" does not consider that the three fortified positions will be of any real use against a simultaneous attack from Bâle, Besançon, and Lyon, particularly if such an invasion be assisted by an Italian advance along the Upper Rhine.

The first position, it says, is established across, not the plain, but six mountain chains and valleys of the Jura, has no proper connection between its various parts, scattered as they are, and would be difficult to reinforce with reserves, and is thus unsuited for defence.

The second position is outflanked by Bâle, it also runs across mountains and valleys, and is, like the first, easily to be turned above Bâle by the valley of the Rhine and the Frickthal; the more so, since a French army would certainly prefer so to manoeuvre as to push a Swiss force to the south, rather than to attack it in front.

The third position, or central fortress, is intended as an entrenched camp, and as such should include the heights which enclose the valleys of the Aar, the Limmat, and the Reuss. It could then dispense with the preceding lines, and could alone resist any invasion.

Colonel Rothpletz, it further says, appears not to intend to fortify Zurich, in which case the enemy will certainly choose that city for his headquarters.

Nor does the Colonel state whether his three lines are to be occupied simultaneously or in turn, nor how the advanced troops are to be withdrawn; nor is there any central point sufficiently fortified which may contain the magazine, storehouses, &c., and, if necessary, shelter the National Government. The fortress Brigg-Baden will not answer this object, which can only be served by a rich and populous town, and Zurich should, for this and also for strategic reasons, be selected as the military centre of Switzerland. Zurich strongly fortified, says the "Zeitung," would prevent the formation of any plan of advance through the country by either France or Germany; it would cover the ground between it and the Rhine; it would cover the left of a

¹ January 1, 1881.

² November 17, 1880.

³ December 18 and 22, 1880.

position facing west on the Limmat and the Lower Aar, and the right of a position facing east on the Glatt, and would cover both towards the south; it would also cover the rear of a position on the Rhine; would command by the lakes of Zurich, Lucerne, and Zug a communication with Lucerne, where could be organized a guerilla war in the valley of the Reuss and on the St. Gothard, which last point is the junction of the upper valleys of the Rhine and Rhone, so that its possession by the Swiss will prevent the position of Zurich from being turned on the south-east by way of the Lake of Constance. This last object might be yet more certainly gained by fortifying a post near Sargans, which can communicate with Zurich by the Lakes Wallensee and Zurich.

The defence of the Jura and its defiles the "Zeitung" considers to be a harder task, and it suggests that, in the case of an invasion by the French, three lines would be selected; the frontier would be attacked in front on the line Besançon-Bienne-Berne, while the flanks would be turned by the two lines Belfort-Bâle-Schaffhausen and Lyon-Geneva-Berne-Zurich-Schaffhausen, of which the latter runs parallel to the Jura.

In order to close the passage of the Jura by advanced forts, much money and many men will be needed, and in any case such a chain might be broken or cut through at some point, and it is perhaps preferable to take up a defensive-offensive position, on the most south-east chain, with the Landwehr supported by four or five fortified points.

Should the Auszug take up a position on the line of the Middle Aar (between Bienne and Brugg), even though defended by entrenchments, and with the fortresses Berne and Zurich on the flanks, it will find it hard to hold in consequence of the fact that it will be commanded by the crests of the Jura.

Indeed the further the defence is placed from the central fortress of Zurich the more difficult it will become, and the fortification of Berne, and still more that of Geneva, is unadvisable, since their communications may be at any moment cut from the Jura. That of Bâle appears more reasonable, but, like Geneva, it is too near to the frontier, and is also difficult to defend on account of the enemy's forts, which occupy commanding hills in its vicinity.

It is possible that political reasons may induce the Swiss to fortify the rich cities Geneva and Bâle, as also perhaps the very distant Bellinzona; but even if Swiss defence be limited to the fortification of Zurich alone, any reproach would be groundless which complained that the mobilization of the army was not properly covered.

The fortification and the stubborn defence of Zurich and of the positions at the St. Gothard and Sargans would cover directly or indirectly the whole of Switzerland so well, that no enemy would dream of attempting to march through it. So says the "Deutsche Heeres Zeitung," and its article, though anonymous, has in itself so great force and truth, that it appears at first sight a complete answer to the question of how to defend Switzerland. But we must remember that it is a German who speaks, and strong as his position seems with regard to the west, south, and even the east boundary, we can find in his plan no scheme for defence against an attack from the north except the bare statement that Zurich covers the ground between itself and the Rhine (12½ miles to Eglisau and 23 to Schaffhausen), and protects the rear of a force on the Rhine, which can only mean that it would offer a refuge to such a force if defeated.

A summary of the principal plans for defence which have been proposed in Switzerland has now been given, and also a short notice of such few comments as have appeared in the French and German press; but there are various points which yet remain to be discussed, and, therefore, at the risk of exceeding the space available for this paper, some remarks are added to show the view which may be taken by an impartial observer.

If we eliminate from the discussion of the question of the defences of Switzerland the opinions of two classes, namely, that portion of the people

who consider that for various reasons no action in this respect is necessary, and those who believe that the true bulwark of the country is the Swiss Army, and that if any preparation is necessary for war, such preparation should be limited to the determination of the probable lines on which an enemy will invade, and to such arrangements as would permit of the hasty construction of entrenchments just before the commencement of hostilities, we yet find that, among skilled and thoughtful men, two opposite opinions have each their advocates.

One party declares for the protection of the frontier by forts or lines in carefully chosen positions, but is willing to allow that it may be wise to select also some points in rear, on the principal strategic routes, in order that, if the enemy should break the frontier guard, there may still be some possibility of resistance.

The other party demands above all a central fortress, which shall afford a rallying-point and pivot for the movements of the field army, which shall protect the arsenal, hospitals, &c., of the country, and which shall be a permanent work occupied and kept up in peace as in war. This party is willing to own that it may be well to close such of the frontier roads as may be easy of defence, but sets its face against anything in any way resembling a cordon of forts.

Before considering these antagonistic schemes, and deciding upon their relative value, it is necessary to consider the object which any plan of defence is intended to serve.

Switzerland, as before mentioned, has two dangers to dread, viz. :—

(i.) She may be invaded by an enemy with a view to conquest and permanent possession.

(ii.) She may be used merely as a means to an end, as a high-road to a more distant objective.

The former of these dangers, should the case actually arise, would be by far the most terrible, for though the latter would for a time almost ruin her by its waste of money and blood, yet to that there would be an end, and the lapse of a few years would enable her, should she retain her independence, to regain her former position. But the former is also the most unlikely case to arise, for it is not to be supposed that any one of her neighbours would be tacitly permitted by the others to occupy territory of so great importance to all; nor is it probable that any attempt of the kind would be made in the face of such certain opposition, while on the other hand it is easy to imagine a combination of circumstances, which would make a temporary occupation of Switzerland not only possible but desirable to any one of her neighbours.

Whether is it better to provide against the more probable or the more deadly danger; or can the same scheme of defence be made to serve both purposes?

The experience of former wars teaches that the objective of a campaign is usually the capital of the country which is invaded, and the fact that the capital has been capable of defence has very much affected the result of many wars; for example, Lisbon in 1810, being protected by the lines of Torres Vedras, was available for the receipt of such stores and reinforcements as finally enabled Wellington to drive Massena out of Portugal, while in 1878 the lines of Kutchuk-Chekmedje, imperfect though they were, prevented an immediate irruption of the Russians into Constantinople.

This truth is certainly entirely recognized by the French, who, warned by their experience in 1814 and 1815, prepared Paris for defence; and since these fortifications, not having been improved in conformity with military changes, failed them in 1871, they have now prepared such an array of fortresses around their capital, as would require an army to garrison, and a nation to besiege them.

A fortified capital enables a people, which has suffered defeat in the field,

to organize new resistance, to repair past losses, or at the worst to make favourable terms for their submission, and none of the arguments as to dissemination of forces, attenuation of the active army, or loss of garrisons shut up in distant fortresses, can apply to such a case.

On the other hand, a line of forts on the frontier is made to be broken through, and such a plan implies the construction of many forts, or lines, of which a few only will be attacked; while the certain eventual loss of those few necessitates the practical failure of the whole line.

From this it follows that a country, and more especially a small country, which desires to preserve to itself the power of stemming the course of a successful invader, must choose for itself, as it were, a core, around which it may collect the remnants of its strength, and whence its army may issue with renewed vigour.

In the case of the majority of countries, this core, this centre, is the capital: but Switzerland has no capital. And, strange to say, she desires none. Though Berne, as the seat of Government, has a species of pre-eminence among Swiss cities, yet neither Bâle, Geneva, or Zurich would acknowledge her to be their superior; and such is the jealousy on this subject among the cantons, that it may possibly be one cause of the objection of many to any central fortress. Each canton has its arsenal, each finds distinct portions of the general army, and in many ways this division of the units of Switzerland is kept up; for example, no canton is permitted to employ more than 300 regular troops, and this for fear lest the ambition of any one should lead it to strive to dominate the others.

The town which is selected for a central fortress must contain the common arsenal, gun factories, powder works, hospitals, &c., and will certainly draw to itself the executive Government of the country, and thus infallibly will become the *de facto*, if the unacknowledged, capital of Switzerland.

But to return to our subject: a central fortress may, partially or wholly, save a country from the full consequences of an unsuccessful resistance against an invasion; can a line of forts, even if they be supported by a second line of defences, answer the same purpose? No! they cannot. They may delay the advance of the invader, and so may give time for mobilization and concentration, but once broken, and the chain must somewhere yield, they affect the remainder of the struggle only so far as they diminish by the number of their garrisons the effective strength of the army of defence.

The second line of entrenchments, placed at points of strategic importance, may assist the field army and delay the end, but scattered as they must be, and wanting cohesion, they will be forced if weak, or turned if strong, and the Swiss Army, in the absence of a national rallying point, will be pushed into the Alps, there to starve in safety.

The system of providing a central fortress must also be the cheaper, for if we suppose that the fortifications of the new capital are equal in number and extent to the defences of Paris (and this all will acknowledge to be a maximum indeed), what defence could be made on the frontier by twenty forts, and assuming the garrison of each of these forts to be 600 strong, how much greater would be the defensive power of 12,000 men working under one command on a front of say 30 miles, than of the same number shut up in independent forts and distributed along the frontier?

Again, if the idea of a fixed capital is repugnant to the minds of the Swiss, that of a standing army is even more hateful; and yet, unless there be some permanent force, how are the daily duties,¹ to say nothing of the repairs, of the scattered forts to be executed, and how are they to be manned at the sudden call of war? But when once the prejudice against a capital is aban-

¹ Such as the traversing of the guns, the painting of the carriages, the care of stores, ammunition, &c.

done, what can be more natural than that this, the centre of Swiss life, should be guarded by the only regular troops ; or, if that be too terrible for a Swiss imagination, then, at least, the ordinary duties of a fortress will fall upon the contingent of a large and populous town, and not upon that of a rural district. To sum up, a central fortress appears to be the cheapest, the most secure, and the most natural defence of Swiss freedom ; and if local feelings are opposed to such a guarantee of the general welfare, local feelings must be forgotten in national patriotism, and the good of Switzerland, not the advantage of this or that canton, must be the object of Swiss endeavour.

But there are two objections which may be urged against any system of defence which consists of a central fortress only, and these are : (i) that no provision is thus made for the protection of the country during mobilization, and (ii) that at the very commencement of hostilities a large portion of the country must be abandoned to the invader.

With regard to (i), it is certain that this danger must continue so long as the present system obtains, by which the forces of the various cantons are mustered, armed, and organized, each in its own district, but if we admit that this mode of procedure may be improved, and that the Swiss Army may be assembled on some definite series of rallying points near the fortress, from the arsenals of which they will be supplied with arms, the mobilization will in that case be secured, and will probably also require less time than at present.

It is wise to look the second objection in the face, and to own at once that some portion of the country must be abandoned to the enemy ; but this will be the case in any event, even if the frontier be fortified ; and in one case a place of refuge and a defence is provided, while the other, when once pierced, affords no shelter or relief.

War must always involve hardship, especially to the poor, but though individuals will suffer by the presence of the enemy, the State will be spared much, if its archives, its treasury, and its magazines be collected within a circle of defences, in place of being divided among various weakly defended points.

Again, it is easy to imagine such an organization as will ensure that the portion of the *Auszug* which lies most near to the arsenal may be armed at once, and sent forward to cover the mobilization of the remainder, which may be brought to their rallying points by the return trains. This vanguard of the *Auszug*, being constantly reinforced, will be competent to venture on more extended operations, and may, if the mobilization be well and expeditiously carried out, be even able to anticipate the arrival of the enemy on the frontier.

But it must not be imagined that because, for the reasons mentioned above, a scheme of defence which depends on a central fortress appears more full of promise than any which is composed of detached forts or lines, that it is, therefore, intended that the Swiss Army shall remain shut up in their defences as an inert garrison. On the contrary, the fortress may be used as a pivot, a support for one or the other flank, or as a source from which supplies and reinforcements may be drawn, but not until every effort has been made in the field, and, fortune or force failing, the troops are broken in heart and reduced in numbers, not until each successive line of mountain and river has been crossed by the enemy, must the Swiss field army cease to struggle in the field ; and, even when the *Auszug* has been driven in under the guns of the fortress, every effort must be made to enable it again to push out beyond the radius of their fire, and to meet the enemy in battle.

Let the Swiss take warning by Metz, Plevna, and Paris, and remember that an army near a fortress may, by judiciously taking advantage of its position, greatly increase its defensive or offensive power ; but that an army which allows itself to be shut up in a fortress takes away more from its capability

of resistance by the number of hungry mouths than it adds by the mass of willing hands.

If it be acknowledged that the first duty of the Swiss rulers is to provide a central fortress as the "hub" of their system, it may also be allowed that their next task, after having armed it with the best and latest ordnance, will be to close with forts of medium size all the passages into their country which are thus capable of being hermetically sealed,¹ and of which the "terrain" is of such a nature that the forts would be impregnable except by famine. Those roads which do not fulfil these conditions should be left open, for a fort which can be destroyed will soon be rendered untenable, and a fort which can be passed will be passed; witness the failure of the fort of Bard to stop the march of Napoleon in 1800.

Were Switzerland a rich and populous country, she might allow herself the luxury of placing a fort with a garrison of from 400 to 600 men on each of the various lines of ingress to the plain, and might thus purchase that which would be of very great value, namely, an additional day or two for the completion of her mobilization.

But she can afford no more, in men or money, than is absolutely necessary, that is to say, the minimum that may secure her from conquest or invasion.

The scheme of defence which will at the least cost delay or defeat a conquest of Switzerland is probably that which takes for its guiding plan the construction of a central fortress, and provided that the position of such a fortress be chosen upon good principles, it will serve also the purpose of discouraging or preventing the passage of an enemy through the country.

The Swiss Government, having made their State secure within, may next turn its attention to the diminution of the number of entrances available to an invader, and, having limited these, may then decide upon the consequent lines which an invasion will follow, and may select positions and plan entrenchments for an intermediate defence.

It now remains to consider which will be a suitable position for this central fortress, in order that it may be the citadel of Switzerland, and may also close, not merely threaten, an enemy's line of advance through the "plain."

It may be assumed, for the reasons stated in the criticism of the "Deutsche Heeres Zeitung" on the system of Colonel Rothpletz,² that the "part" of central fortress must be played by some large and important town, and of such Switzerland possesses four, namely, Bâle, Geneva, Berne, and Zurich.

The two former are out of the question, by reason of their nearness to the frontier, and the choice thus lies between the two latter, which have been selected for the purpose by Colonel Siegfried.

As we are in this paper concerned only with the defence of the northern and western frontiers, it is necessary to examine the question with reference alone to an invasion by France or Germany.

Such an invasion, it may be granted, will, more or less directly, follow the line of the plain, and the direction of this line may be best understood by studying the direction and junctions of the railroads.

The five principal lines which pass into the "plain" from south to west run as follows :—

Belfort-Bâle					
Pontarlier	} Bienne	} Soleure	} Olten	} Brugg.	
Morteaux					
Lausanne					
Lausanne-Berne					

¹ The St. Gothard Pass, for example, might be rendered absolutely proof against an invader by one small fort.

² Page 866.

It is thus evident that Brugg is the key of the system of railways from the French frontier to Schaffhausen ; but this point may be turned by the line Berne-Lucerne-Zurich, and Brugg is not of sufficient importance to be accepted as a site for a central fortress, though it is probable that it must be included in any system of defence.

The city of Berne has very great claims, politically speaking, to be made the nucleus of a system of defence ; it is central, it has excellent communications with all parts of the country, it is covered by the line of the Sarine as well as by that of the Aar, and it has further the prestige of being the seat of Government.

If Berne were held, there would be no need to abandon the valley of the Aar, and the enemy would be restrained from ravaging the most fertile and valuable portion of Swiss territory.

But Berne has not, by the fault of its position, the absolutely essential quality of strategical offence. It is not *in the way* of an invader, French or German, nor does it defend the Rhine frontier or the Jura.

As a central fortress in the case of a threatened conquest of Switzerland, Berne would be of great value, but as an obstacle to a passage of the country by an enemy, it would be almost useless ; for the French would by its resistance be deprived of only one line of rail (Lausanne-Olten), and that the least direct to their object, while any offensive operation by a Swiss Army from the neighbourhood of Berne would commence at such a distance from the communications of the French, that the latter would have ample time to concentrate in any direction, and to prepare for the attack.

It is unlikely that Berne would prevent the passage of the French to the Upper Rhine to any greater degree than Metz hindered the investment of Paris, while it is absolutely out of the field of German operations against France, and could give no support to the Swiss field army, which could probably be held in check by a detached force on the Aar. On the other hand, the line of the Limmat and the Aar, from Zurich to Coblenz, absolutely closes the "plain," and that at its narrowest point ; every railway and almost every road of the "plain" crosses the rivers between these two places, and this line, which is about 20 miles in length, would, if occupied in strength, bar all communication between France and Germany by way of Switzerland.

Brugg, the central point of the line, being, for reasons before mentioned, unsuited for the character of Federal fortress, there is no choice but to fall back upon Zurich as the point which should be made the nucleus of Swiss defence.

With regard to an attack from France, the position of Zurich is certainly eccentric, but it is probable that, were the plan of the invasion of Switzerland ever to become from any cause a temptation to the French, the certainty of strong resistance and of possible defeat on the strong line of the Limmat, supported by the fortress of Zurich, would cause any such scheme to be abandoned.

It is true that Zurich is so near to the German frontier that it might be beleaguered before the completion of the mobilization of the Swiss Army, but any advance from Germany may be delayed by the timely destruction or the skilful defence of the bridges on the Rhine ; while the campaign of Massena in 1799 shows how great a defence against an invader from the north is the line of the Limmat which he occupied.

It has been already shown by the "Deutsche Heeres Zeitung" how materially the fortification of Zurich would assist the defence of the eastern frontier, and all evidence on the subject appears to lead to the conclusion that Zurich will be selected as the first site for the new fortifications of Switzerland, and as the centre of her system of defence.

Space will not admit of the discussion of the question from the point of view of finance, but in some of the pamphlets on the subject facts have been

brought forward which prove that the Swiss, who at present pay but 6 francs per head for their defence, against 19·5¹ for France, and 23·5¹ for England, may, if they please to submit to a moderate burden in addition, set at rest once and for ever the question of the "to be or not to be" of the neutrality and independence of their country.

ELECTRICITY AT THE PARIS EXHIBITION AS APPLIED TO MILITARY WORK.

By Major ARMSTRONG, R.E., S.M.E., Chatham.

THE Electrical Exhibition held in the Palais de l'Industrie, Paris, from September to November, 1881, contained little that was novel to any person who is acquainted with the current electrical writings of the day. This might have been reasonably anticipated by an intending visitor, as discoveries, when they are sufficiently advanced to be presented to the public, are disclosed by the numerous journals now wholly or partially devoted to the subject of electricity, either as patents or as direct communications to some society or paper. The information to be acquired lay chiefly in the comparison of different patterns of apparatus placed in proximity with each other, in many cases actually at work. To describe in detail all the several apparatus which was of interest, would cause this communication to exceed all limits of reasonable length, and would further, as has already been pointed out, be traversing ground previously gone over by electrical journals; it is therefore proposed here as a rule to confine our attention to the indication of the points in which certain apparatus of importance in military or semi-military work displayed a superiority over others.

Concurrently with the Exhibition a Congress composed of delegates from the United States of America, Japan, and all European Governments, held sittings for the discussion of electrical matters, of which the most important was the determination of a satisfactory universal series of standards of electrical measurement.

The decision was as follows, viz:—

- " 1.—On adoptera pour les mesures électriques les unités fondamentales : Centimètre, gramme masse, seconde (C.G.S.) ;
- " 2.—Les unités pratiques, l'ohm et le volt, conserveront leurs définitions actuelles : 10⁹ pour l'ohm et 10⁸ pour le volt ;
- " 3.—L'unité de résistance (ohm) sera représentée par une colonne de mercure d'un millimètre carré de section à la température de zéro degré centigrade ;
- " 4.—Une Commission Internationale sera chargée de déterminer, par de nouvelles expériences, pour la pratique, la longueur de la colonne de mercure d'un millimètre carré de section à la température de zéro degré centigrade qui représentera la valeur de l'ohm.
- " A ces quatre premières résolutions ont été ajoutées les trois propositions suivantes :
- " 5.—On appelle Ampère le courant produit par un volt dans un ohm.
- " 6.—On appelle Coulomb la quantité d'électricité définie par la condition qu'un Ampère donne un Coulomb par seconde ;
- " 7.—On appelle Farad la capacité définie par la condition qu'un Coulomb dans un Farad donne un volt."

The adoption of the above definitions of the standards of electrical measurement will make little practical change in the values of the units at present

¹ Army and Navy.

employed in England, while it will remove the inconvenience, which now exists, of the three standards of resistance used, viz : The British Association unit in England ; the Siemens unit in Germany ; and the "length of wire" of some gauge, &c., not generally known, used in France. At present also the unit of current used in Germany is $\frac{1}{10}$ th of that used in England, being called a Weber in both countries from the name of the experimenter who fixed the German unit. In the above resolutions it will be seen that the English unit of current is adopted under the name of an Ampère.

The 6th and 7th resolutions remove a confusion which has existed as regards current, quantity, and capacity : the term Weber having been used to express both the current which is produced in an ohm by a volt, and also the quantity of electricity which is conveyed by such a current in a second. Others, again, used the term Farad, both for the unit of capacity and of quantity.

From the latest measurements it is probably that the value of the ohm as adopted in the English standard coils will be reduced by about 5 per cent. in accordance with resolution 4.

It is much to be regretted that the Congress did nothing towards fixing a standard for the comparison of the illuminating power of different lights. This is a subject of very great difficulty, on which there is much difference of opinion, as described later on.

Bjerkness' Experiments.

The first object to be noticed in natural sequence was an exhibit by Professor Bjerkness, of the University of Christiania, of an apparatus designed to elucidate certain fundamental phenomena in electricity and magnetism by analogous hydrodynamical action.

It has been for a considerable time practically admitted by electricians that what are known as electrical and magnetical phenomena are *de facto* caused by a vibratory condition, either of the molecules or of the ether of the matter in which the phenomena are observed.

Professor Bjerkness seeks to establish the truth of this view, by showing that attraction and repulsion forces are exhibited by a small drum freely suspended in water, when another similar drum is brought into its presence, rapid synchronous vibrations being caused in the elastic ends of the drums by a small specially arranged air pump. Repulsion takes place when the opposed ends of the respective drums are both convex or both concave at the same instant, and attraction occurs when one is concave and the other convex.

The Ader Telephone.

The crowds which assembled nightly during the three months through which the Exhibition lasted to hear for a few moments the performance of the Ader Telephone in connection with the Grand Opera are evidence of the success of this modification of the instrument. It is very nearly the same as the Gower-Bell telephone, employing a horse-shoe magnet of great power with a small electro-magnet bobbin attached to each pole : the vibrating diaphragm is only half the size of that used in the Gower-Bell pattern, and close outside it, but not in contact, comes another iron ring with a hole in its centre for the entry or exit of the sounds passing between the stations. This telephone is wonderfully clear in its articulation, leaving apparently hardly anything to be desired in that respect. Its superiority probably lies in the smaller size of the vibrating diaphragm, which must be less distorted under the attraction of the powerful horse-shoe magnet than is the case in the instrument with which it has been compared, and which is probably the loudest of the Bell species of telephone.

It has been remarked as a curious phenomenon, for which different explanations have been given, that the direction of movement of a singer was *heard* in

the telephone. The writer was informed that this effect was due simply to the fact that the two telephones employed by each listener were connected independently to different microphones on either side of the prompter's box. Whether this be the true explanation or no, it is certain that the facts were as stated above, and that they added considerably to the interest of the performance. With these instruments a receiving clerk in a military office would have no excuse for inaccuracy on the ground that the message was not distinct.

The transmitters used in the opera houses in connection with the telephones placed in the Exhibition building were very similar to Crossley's pattern. The experience of many persons is, however, that the Blake transmitter is superior to Crossley's. In the former the microphonic contact is between a platinum point and a carbon disc attached to the centre of a thin metallic diaphragm; in the latter the contact is between a number of carbon pencils and blocks of carbon which support them, the pencils being arranged horizontally, instead of vertically as in the earliest instruments.

Edison's Autographic Telegraph.

In the Exhibition of 1878, an apparatus, the invention of M. D'Arincourt, was brought to notice, by which plans could be transmitted by electricity, and as another application of the instrument is evidently to transmit an exact copy of an order as written by a general or staff officer, the invention merited attention. The effect was produced by having at each station a revolving cylinder moving uniformly, and that at the receiving station moving a little the faster of the two. One drum contained the message written in non-conducting ink on a metallic paper, and the other drum contained a chemically prepared roll of paper, intended to be marked by the passage of a current of electricity through it. Each drum was traversed during its revolution by a platinum point, that at the sending station being in connection with a battery and the cylinder in connection with the line. By this means a continuous current was sent along the line, except at the moments in which the point was moving over the non-conducting ink, and, by the aid of a specially arranged relay at the other end of the line, a current was passed through the prepared paper on that drum at the moment when the line current was broken in the way indicated above. Both papers were therefore similarly marked. When the drum at the receiving station had made a complete revolution it stopped until the sending drum had also completed one turn, when the former was again started by an escapement released by the current sent at that moment from the distant station. Both the styles were meanwhile working down a worm which caused them to traverse a fresh section of the paper in each succeeding revolution.

The foregoing method required large battery power, and had the further disadvantage that the battery at the receiving station was short circuited for a considerable portion of the time. Edison, with his usual practical fertility, has overcome these defects as follows, viz: adopting the main principle above described, as regards the movements of the cylinders, &c., he employs at the sending station ordinary paper, on which the plan or message has been written firmly with a common pencil. The style which traverses the paper in this case during its revolution is a delicately adjusted key which, so long as it travels over the level surface of the paper, keeps the circuit open, but on dipping into the several depressions made by the message, it closes the circuit, and the *line current* thus sent makes the corresponding marks at the other station. Edison produced his uniformity of revolution by heavy balls driven electrically in horizontal circles, and working cranks connected to the axes of the cylinders by universal joints, an arrangement which added much to the weight and bulk of the apparatus; this, however, could be replaced by clockwork. The disturbances caused by the charge and discharge

of the line are said to be obviated by coupling an electro-magnet in divided circuit with the receiving instrument.

Field Telegraphs.

France, Belgium, Sweden, Austria, and the United States exhibited portions of their field telegraph equipment. The three first-mentioned countries still mainly depend on their cable train, the two latter and England, on the other hand, are now mainly employing aerial lines. It is, therefore, chiefly from the Austrian and American equipments that hints would be sought for the improvement of the field telegraph equipment of this country. The Austrian arrangements were very complete and their waggons were light, the chief point to be noticed being their employment of bamboo telegraph poles, which only weigh about half as much as pine poles of equal strength. The difficulty in the employment of bamboos has been the fact that they were found to perish in store. This difficulty has been overcome by careful selection and by plugging the ends with plaster of Paris to prevent the entry of insects.

The United States exhibited waggons of the pattern used in their civil war: according to the custom of the country these waggons were of very light construction. This was the only field telegraph in the Exhibition in which neither telegraph recorders nor telephones were employed; the latter were doubtless omitted owing to the fact that it is only within the last couple of years that the value of the telephone as a field sounder has been generally appreciated: the recorders were omitted through the desire to keep everything in the whole organization of the most extreme simplicity.

Elisha Gray's Harmonic System of Multiplex Telegraphy.

The apparatus exhibited sent five harmonic signals along a single wire simultaneously in one direction, and to these were added an ordinary duplex, thus making six messages sent in one direction, with the power of interruption by the receiving station if desired. In this system the vibratory currents leave the sending station through a system of contacts rapidly interrupted by metallic reeds tuned to different notes; for each note thus sent there is at the receiving station a corresponding electro-magnet which attracts an armature attached to a reed tuned in unison with the note to which it is to answer. The received currents all pass through each receiver, but the latter only respond to their respective tones. When it is desired to send a message, the reeds are started in vibration, and the signals are formed by interrupting the vibration of one of the tones for the period of time representing the dot or dash of Morse telegraphy. This is done by the sender substituting for one of the vibration currents a continuous current of such strength that its effect on the duplex arrangement will be equivalent to that of the vibratory current which it replaces. The signals are thus correctly received on the corresponding reed at the other station, without disturbing the working of the duplex.

To many no doubt the above arrangement will be familiar, but the ingenious and simple method adopted for recording the messages sent by this system is not so generally known. It will be seen that the problem is how to cause a reed, vibrating with the minute and rapid movement which emits a musical note, to make long and short marks on a paper. The solution is as follows, viz.: on the end of the reed lies a very light contact lever connected with an ordinary local Morse recorder and battery in the regular way, so that while there is contact between the lever and the reed, a mark will be made on the recorder paper. Now while the fork is vibrating this contact is not good enough for the passage of the local marking current, but when the vibration is stopped on a signal being transmitted in the manner already described, the requisite contact is established, and the record is made on the paper slip.

The number of messages which can be sent by the harmonic system simultaneously is only limited by the number of tones which are sufficiently far apart to be free from interference with each other, and this appears to be five. It is stated that this system can also be duplexed; it was not, however, so working in the Exhibition, the duplex employed being, as already stated, an ordinary electro-magnet duplex.

The Electric Light.

Looked at from a professional point of view, the employment of the electric light for the purely military purposes of disclosing an enemy's operations is by far the most important of its applications, although in an exhibition of the kind now being commented on the apparatus devised for this purpose occupied a very insignificant position.

Where movability is not an essential feature of the apparatus, there does not appear to be any theoretical limit that could with advantage be laid down for the power of the Search Light to be employed. Certainly no apparatus has yet been met with which, considering the long range of modern firearms, the diminution caused in the intensity of the light by a little mist or smoke, &c., can be considered to satisfactorily meet our requirements. The complete apparatus designed for the defence of fortresses in which the boiler, engines, and electric generator are all mounted on one trolley weighing together from two to four tons, as manufactured by Messrs. Siemens and Messrs. Sautter and Lemonnier for foreign Governments, appears to be a step in the wrong direction. If movability of the light be required, as is no doubt desirable in most cases, it can be arranged for without limiting the size or power of the generators, by simply moving the lamp; permanent conductors would no doubt be necessary for this arrangement, but there would be no economical or engineering reason against their provision. The power of light produced by the apparatus weighing two tons alluded to above would only be about two-thirds of that given by the D Gramme adopted for the defence of British fortresses.

The French Government also exhibited a smaller light for field use, mounted in a similar way to the above. The machine employed was the A Gramme, giving a light of about 6,000 candles. It was worked by a three-cylinder Brotherhood engine driven from a small field boiler, the whole being mounted on an iron truck weighing probably one and a quarter tons.

The projector used for condensing the beams of light, and concentrating them in one direction, was the Mangin catoptric arrangement also used in our service; this, with Sautter and Lemonnier's inclined hand lamp, and the cable conductors for leading the current from the generator, were carried on a separate hand truck.

No pattern of apparatus for the production of the light in the field by horse-power, or the equivalent in man-power, was exhibited. Such an apparatus would be useful in the small savage wars in which England is involved from time to time.

It has just been stated that, in the system of condensing the rays of light employed by the French Army, the Mangin projector is used. As this is the description of apparatus preferred also in England, a comparison between it and the Holophote used elsewhere may not be uninteresting.

The Holophote, which is used also in those lighthouses in which a beam in one direction is required, is a catadioptric apparatus consisting of a Fresnel lens with a six-inch focus to collect the front rays, and a small hemispherical metallic reflector to return the back rays to the front, where they also are collected by the lens itself and combined with the other rays already parallelized. The lens itself consists of a number of concentric prismatic rings of ground glass arranged round a solid centre: in the central portion the curves are so arranged as to nearly parallelize the rays by refraction, while in the outer

portion the same result is produced by total internal reflection. The angle of the cone of rays ordinarily projected is about 12° to 16° . The defect of this apparatus is that, owing to the short focal distance, the rings of glass are liable to be broken by the intense heat of the arc, and the movements of the arc and alterations in the shape of the crater render it difficult to focus the light.

These defects are completely overcome in the Mangin projector, which is the design of Colonel Mangin of the French Engineers. The projector is used altogether as a reflector, the most brilliant portion of the electric arc and crater being turned to the rear, and the front rays being neglected. The reflection takes place from an enormous glass lens (the largest size is 2' 6" in diameter), of which the two faces are spheroids of such respective curvatures that, by silvering the rear surface, the reflected rays emerge in nearly parallel lines from the front of the glass. The focal distance is about 2 feet, and the angle of the cone of light projected is about $2\frac{1}{2}^{\circ}$. Whenever it is desirable to obtain lateral spread of the rays at the expense of range, an extra lens is employed in front which gives the beam the shape of a horizontal fan.

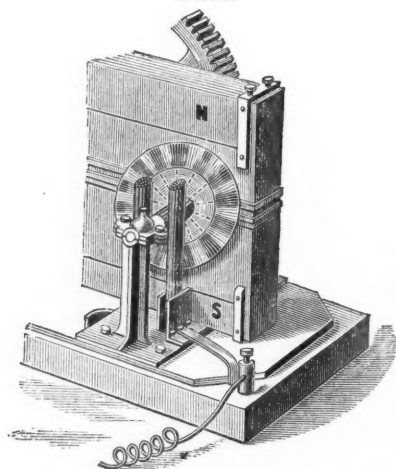
The inclined lamp which is employed with the above projector is designed by Messrs. Sautter and Lemonnier. The advantage of this lamp is that, by inclining the top backwards at the angle of about 20° , the glowing surface of the upper or positive carbon from which the greater portion of the light is obtained points more directly to the front.

Comparison of different species of Electric Light Generators.

The generators employed for the production of arc lights may be divided into three species, all of which were largely represented at the Exhibition, viz., alternating current machines, and the direct current machines of the respective types of the Gramme and Siemens Alteneck patterns.

In all these machines the currents are produced by the movement of coils of wire in a magnetic field, that is to say, in the vicinity of magnets either permanent or electro.

FIG. 1.



In the first named species, currents of alternating direction are produced by the passage of the revolving coils through successive magnetic fields of alternate polarities, the current generated by the passage through a north field being in the opposite direction to that produced by the passage through a south field, *see* Fig. 1.

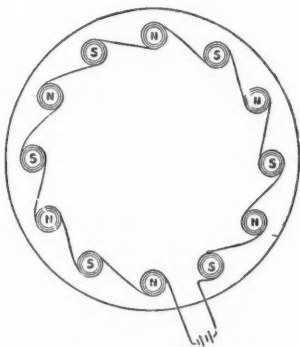
The main advantage of this class of machines is that, owing to the rapid change in the direction of the currents, the two carbon points are equally heated, and therefore burn away equally, thus preserving their focus: further, the focus is in the first instance more quickly obtained owing to the light being confined to a smaller space than is the case with direct currents. The principles of construction are simple in their application, and repair can be effected by unskilled men.

For military work, however, they have the great defect that they give a much smaller candle power than the other species of generators of corresponding size, and they are rather dangerous to handle, as if a man gets hold of the conducting wires he cannot let go and will be galvanized to death unless assistance arrives in time.

The Gramme Ring.

The principle of the "Gramme ring" was discovered by the Italian Pacinotti many years ago, but has lain unutilized until taken up by the inventor whose name it bears, within say the last six or eight years. The coils of wire (*see* Fig. 2) in which the current is to be generated, are connected together so as to

FIG. 2.



form a ring, which is then rotated round its centre in proximity to stationary magnets, the upper half of the ring being enveloped by say a north pole and the lower half by a south pole.

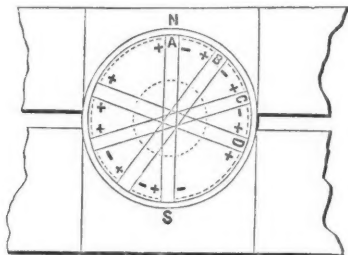
The movement of the several coils forming the upper half of the ring in the north magnetic field generates currents of electricity in each coil, and all in the same direction as they are wound similarly; by means of wire brushes and a special arrangement of bars which are connected to the junctions of the several coils with each other, and are then laid parallel to each other along the length of the revolving axle, the current can be taken continuously from the coils which for the time being are within the magnetic field now under consideration. As each coil leaves the north magnetic field it becomes inert or nearly so, and when it enters the south field the current in it is reversed; it is evident, therefore, that the current issuing from the lower

half of the ring is in the opposite direction to that obtained from the upper, and therefore, from the arrangement of brushes just described, the effect is that of two batteries coupled for surface or quantity (as it is sometimes termed) of which the tension will be the same as that of each half of the total battery, and the internal resistance will be one-half of the same.

By the insertion of a continuous iron core in the revolving coils of wire, the effect is much intensified, for the portion of the core in propinquity with the upper and lower magnets respectively is magnetized inductively with magnetism of the opposite sign, and while the ring revolves its magnetism remains fixed.

The upper half of the wire of the uppermost coils and the lower half of the wire of the lowermost coils are thus each acted on by a double magnetic field and the effect is proportionately augmented.

FIG. 3.



The original true Siemens "Armature," as the revolving bobbin is called, was of the alternating type,¹ see Fig. 3, one large bobbin revolving on a horizontal diameter in the magnetic fields produced by a single pair of powerful magnets: when used for the electric light the currents were turned in the same direction continuously by a commutator which reversed the connection of the wires with the circuit, at the same moment as the position of the coil with reference to the magnetic field was reversed.

When the effect of the continuous currents of the Gramme ring became known Herr von Altenek forthwith applied the same principle to the Siemens armature.

Retaining the cylindrical core on which the Siemens bobbin was wound, he substituted for the single coil hitherto used a number of double coils completely covering the surface of the core. Viewing the end elevation of the bobbin so wound it presents the appearance of a circle, over several equally spaced diameters of which pairs of coils are wound. Each pair of coils has four ends, and in their revolution in the magnetic fields, positive currents issue of necessity from two of the ends, while negative currents flow from the other two; one positive and one negative end are led out at the top of the ring, and the other pair of ends are led out at the bottom. The armature therefore when fully wound consists of a number of coils of wire through which currents of electricity are flowing, and it is only necessary to connect the top series of ends and the series of bottom ends respectively so that the currents of the upper series shall assist each other and be in the opposite direction to the lower series. The remainder of the action is the same as that of the Gramme

¹ In the figure, if only one of the coils be considered as existing on the bobbin, we have the original Siemens armature.

ring, and it will be seen that this machine has the great advantage of having all its revolving wire close to the field magnets.

Adequate reasons have been given against the employment of the alternating machines for military search lights, and the choice therefore rests between the numerous apparatus on the two direct current principles just described.

Assuming that the requisite power and simplicity of action can be ensured in any of the patterns, the most suitable machine will be that in which the repairs can be readily effected: this is an important proviso as regards machines to be used out of England, and its adoption will eliminate a large number of patterns. Lastly, the choice will turn upon the question of first cost and efficiency.

The efficiency of a machine is the ratio between the useful work recovered and the work expended, and it is evident that the first cost of the entire arrangement to produce the light will be intimately connected with the efficiency: for instance, it would be very false economy to produce an electric generator at a low price if it were of a pattern requiring extra size of boilers and engines for the production of a given amount of work.

The following patterns of machines seem well adapted for the purpose, viz.: Schukert, Gulcher, Brush, Jürgensen, Naglo, Edison. The first five are modifications of the Gramme ring, and the two last of the Siemens Alteneck armature. In all of them the greater portion of the moving wire is well under the influence of the field magnets, and repairs are simple in all except the last, in which no doubt this could be readily arranged for. The Schukert, Gulcher, and Brush machines use flat or rather flat coils, and apply the magnetism at the sides. The Jürgensen machine employs a Gramme ring of large diameter with a magnetic field on the inside of the coils as well as on the outside; the inventor states that he gets 25 per cent. more power when using these interior magnets. It has the mechanical defect that, in order to admit of the presence of the interior fixed magnets, the ring can only be secured at one end.

The Naglo and Edison machines have all their wire well under the influence of the magnets, as a natural consequence of their adoption of the Siemens armature. In the Naglo pattern the sections of coils are kept apart by small wooden pegs, thus facilitating repairs. The speciality of the Edison machine is in his insulation of the coils with mica strips and in his employment of very large columnar field magnets, on which very thick wire can be wound and the resistance of the machine thus be proportionately diminished.

Magneto Generators.

It has hitherto been taken almost as an axiom that machines constructed on the dynamo principle are necessarily much cheaper than magneto machines. Since the discovery, however, of the iron from which the present powerful permanent magnets are made, it is very doubtful whether on the whole magneto machines are not the more economical of the two. No doubt size for size the dynamo machine will be the stronger and therefore the cheaper in itself, but its economy is reduced by, firstly, the electrical resistance of the wire used to excite the electro-magnets; and, secondly, by the extra power necessary to be given to the steam engine in order to work (satisfactorily) a light when the arc becomes less than normal, and the consequent reduplicating effect of the increased current is felt in the system.

Messrs. De Meritens have constructed one of these machines which, after extended trial in one of our lighthouses, is reported to have given the greatest satisfaction, being considered preferable to all patterns previously tried. It must be remembered, however, that the conditions of lighthouse illumination differ from those of military search lights. The latter must always have a

man to attend upon and direct them who will lengthen the arc, &c., at once in the event of its becoming too short; while the former are expected to burn safely and steadily without much attention. In the event of the arc furnished by a dynamo remaining too short for any great length of time, the coils of the machine will be injured, while the current in the magneto machine being not nearly so much intensified under similar circumstances will not injure its wires.

The internal resistance of one of the large machines is only 0.065 ohms.

As regards the details of construction, Mr De Meritens employs a Gramme ring of large diameter, and therefore apparently easily repaired, which revolves in the field of two large compound magnets when direct currents are required, and in the field of a number of horse-shoe magnets presenting successively their north and south poles when alternating currents are required.

Ordinary Electric Lighting.

Although, when different lamps were examined critically, imperfections in their working were very apparent, yet the general effect of the lighting of the building was very fine, leaving a most favourable impression on the mind as regards the suitability of the electric light for such purposes. It must, however, be remembered that the amount of power used was probably very far in excess of what would be considered allowable under any ordinary circumstances, and a fairer comparison with present methods of lighting for general practical purposes can be obtained in different places in London which are lit by the electric light; for instance, South Kensington Museum, the British Museum, &c. If the question were simply one of light it is very doubtful whether electricity has as yet any decided advantages for general purposes, but there can be no question as to the advantages gained in the greater purity of the air where it is substituted for gas, in the economy and other merits of cleanliness, and in the small total amount of heat evolved, whereby warming and lighting arrangements are made independent of each other. It will also probably be on the whole found far safer to life and property than its competitor the explosive, inflammable gas.

Before passing on to the consideration of the different methods of electric lighting in detail, it is worth while to allude to the fact that this comparatively safe agent set the Exhibition building on fire at the very beginning, and nearly killed one man. The first of these accidents was due to a pair of main conductors, which came in contact and being separated formed the usual electric arc at the original point of connection. Fortunately this was soon discovered on the occasion just referred to; as a source of danger it can probably be provided against.

The second accident happened to an experienced employé who was handling a lamp worked by a high tension machine; the current passed through him to the damp earth of the building, and he was unable to let go; most of the spectators, it is said, on hearing his cries ran away, but one man with less discretion than the others, went to his assistance and *accidentally* raised his feet from the ground, thus breaking the circuit and releasing him.

The risk of this class of accident will be chiefly experienced by those employed in the management of the apparatus, and so far will not affect the general question of the introduction of the electric light into buildings; there is, however, appreciable risk to consumers or their servants who may not be acquainted with electrical action. The point is evidently worthy of serious attention in the selection of apparatus to be worked by the servants of the Government for economical purposes.

While admitting the importance of the previous considerations, the main point as regards general lighting will be, which is the cheapest agent, gas or electricity? This question does not at present admit of a satisfactory answer

in cases not previously experimented on. The difficulty lies in the different colours of the lights; gas is a yellow light, while the cheaper forms of the electric light are much redder and bluer than gaslight, and there is no generally acknowledged means of comparing their relative powers of illumination. The French method is to employ as a standard the *Bec Carcel*, which is a moderator lamp regulated as far as possible to burn a given weight of oil per hour. It gives a yellow light of approximately ten ordinary candles, and is moved to or from an opaque rod, until the shadows cast by the light under trial, which remains at a fixed distance, is of the same intensity as that cast by the *Bec*: the intensities of the lights will then be inversely as the squares of their respective distances from the rod. This was the method adopted in the comparisons made by the jury. Its defect is that with lights of different colours it is impossible to say when the two shadows are of equal intensity, and that there is a large margin of error in the management of the lamp.

The comparison of the shadows can be effected accurately by what is known as the absorption method, in which consecutive measurements are taken with green and red glasses interposed between the sources of light and the shadow-rod. The shadows are then of the same colour, but only those rays are measured which pass through the particular coloured glasses employed, and the important yellow rays are not measured at all, and have to be estimated from the proportion between the red and green measurements, or red and green candles as they are called.

It was argued strongly in the discussions of the jury, that the standard which would be most free from variations such as are caused by the management of the lamp, and the quantity of oil, &c., would be an incandescent substance of recognized purity and dimensions maintained at a known temperature by definite electrical currents: as, however, there is little experience of this system it was resolved to employ the ordinary methods.

It will be seen that, even when the above class of standard shall be perfected, it will not enable the experimenter to compare different coloured lights. It is not impossible that, on the whole, the best basis for such comparisons will be the respective distances from the lights at which a given type can be read.

The information acquired by such a method, if not very scientific or accurate, is of a very practical nature.

The comparison between a light of 10,000 candles and one of 10 candles is evidently affected unduly by inaccuracy of measurement of distance, and requires a long dark gallery for the measurement. Messrs. Ayrton and Perry exhibited a photometer constructed on what is known as the dispersion method, in which a lens is employed to disperse the stronger light to a known amount. In this apparatus, which can be carried in the hand, a sperm candle is the standard. Their measurements are taken in green and red candles.

The different lights exhibited may be divided into four classes, viz.: large and small arc lights, and large and small incandescent lights, and in general terms it may be stated that the higher the temperature of the class of light the more economical it will be, that is to say, the heat being taken as an exact measure of the work done in the luminous body, a given quantity of heat will give more light in proportion as the temperature rises. This may not be accurately true of the very highest temperatures where the light is extremely blue, but in the more moderate of the high temperatures where there is a fair proportion of red rays it is true, and it is the more remarkable the lower the temperature falls, until the point is reached at which heat is produced without any light at all.

From this it follows that the largest arc lights are the most economical provided the space to be lit is approximately an equilateral figure. There is no doubt as to these lights being cheaper than gas.

As the spaces to be lit are smaller, smaller arc lights are necessitated. These still are cheaper than gas. In the attempt still further to diminish the

power of a single electric light, we are driven below the temperature at which an arc will be maintained in air, and have to employ incandescent carbon. If this will stand such a high temperature as to give the light a decidedly white colour they are probably still economical if the space they are required for be of suitable size; but when in the effort to light ordinary rooms we are driven to the yellow incandescent lights of Swan, Lane-Fox, Edison, and Maxim, the margin of saving on either side appears to be slight, and with present arrangements will require further experiment before a definite opinion can be pronounced.

The Brush Light.

If we except Edison and Maxim, who are working on the incandescent systems chiefly, the greatest division of the arc light has been effected by the Anglo-American Brush Electric Light Company, which with an expenditure of about 35 horse power produces 40 lights in a continuous direct current circuit, recovering about 0.536 horse power in each lamp. The electromotive force of the machine is said to be 2,000 volts and its internal resistance when cold is about 22 ohms. This enormous electromotive force is dangerous. The machine when wound with wire suitable for the production of a single light burns carbons $2\frac{1}{4}$ " in diameter giving out enormous light and heat. In this shape, however, the light is not at present manageable.

The Brush lamps are of very simple construction. They are on what is known as the differential principle, that is to say, the action is regulated by an armature working under the influence of two opposing electro-magnets, one of which is in the main light circuit, and the other connected as a shunt on the arc. When, owing to the consumption of the carbons, the arc becomes long and its resistance in consequence high, the current in the main circuit is reduced, the pull of the electro-magnet in that circuit is diminished proportionally; at the same time, by the law of divided circuits the current through the opposing shunt electro-magnet is increased and the armature is drawn towards it, releasing the upper carbon which moves down until the shortened arc attains once more a normal resistance and the armature is in consequence attracted back to its original position: in returning, the armature works the gripping catch of the carbon in a skew position, thus checking the motion. In order to avoid acceleration of the motion of the carbon when it is released in the way described above, it is attached to a piston working in a cylinder filled with glycerine. An automatic switch is provided, which shifts the circuit to a second pair of carbons (contained in the lamp) as soon as the first pair are burned out.

This lamp is very simple in its action and construction, and appears to work with certainty. The light as shown in the Exhibition was not, however, quite steady: this was probably due to the fact that the "feed," as it is technically termed, is by jumps, even though they be not very large movements.

The Brush Company have also sixteen-light and six-light machines, with electromotive forces respectively of 800 and 300 volts working on the same principle.

Messrs. Crompton and Company do not attempt such a division of the light at present, the maximum number of lamps which they supply from one machine being, it is believed, not more than six. They employ another modification of the Gramme principle known as the Burgin machine. In this apparatus the "ring" is divided into a number of small circular or rather hexagonal sections, each containing six separate bobbins, the whole being arranged and connected to pass successively out of one magnetic field into the other. By this division of the ring the armature is kept cool. It is also claimed that the intensification of the magnetism in the core produced by

leaving spaces between the bobbins unwound with wire, by means of which they can be brought nearer the poles, increases the power of the machine.

The large employment of cast iron in this machine diminishes its first cost.¹ Messrs. Crompton also employ a differential lamp, regulating the movement of the upper carbon by wheelwork instead of a glycerine piston, the chief point of merit in this lamp being the delicacy of the feed governor, which instead of being the large armature employed in other systems as described, for instance, in the account of the Brush system, is a light "jockey" armature mounted on the large armature. The function of the latter is simply to open the arc, and after that is established the "jockey" is worked by the differential action already described. It acts quickly, releasing or checking the upper carbon by the aid of a lever acting as a break on the flywheel of the wheelwork. This lamp, however, also feeds by jumps.

Messrs. Siemens and M. Lachasse of Belgium exhibit efficient alternating current machines constructed on the principles described earlier in this paper. That system affords great facilities for the division of the light, as a machine may be constructed of a revolving bobbin moving in front of a series of alternate magnetic poles, and each moving bobbin may be made to feed one or more lamps in continuous circuit, according to the amount of wire on the bobbin. When used in this way a separate lamp circuit is required for each bobbin, which is practically a distinct machine. Messrs. Siemens construct machines giving thirty-two lights on this principle. The danger of the alternating current has been already alluded to. The lamps previously described have as stated the defect of feeding by jumps which cause periodical flickering. Messrs. Siemens and others have, however, designed lamps which, theoretically at least, feed continuously. These lamps are on the differential principle, and are constructed as follows, viz.: two hollow helices are placed in the circuit in the manner of other differential lamps, the low resistance helix being some distance above the other: in the centre of the helices moves a soft iron core to which the upper carbon is attached. The carbons are attached by cords passing over pulleys so placed that the descent of the upper carbon will raise the lower and *vice versa*. If, then, the arc be too short, the greater suction of the upper helix tends to lengthen it by drawing the core with the upper carbon attached, and when on the other hand the arc becomes too long, the lower helix becomes stronger and the arc shortens.

The Pilsen lamp is on the above principle, but an effort is made to regulate the proportion of the strength of the helices when the core is in different positions. It is asserted that this object is attained by tapering the core and thus weakening the attraction when the core is in the *position* of strongest suction, that is to say, just at the entry of the helix. This lamp received a gold medal.

In all the foregoing lamps, however, the light flickers from time to time, owing to draughts of air or the shifting of the position of the arc from some cause or other. When absolute steadiness is required, some description of incandescent light must be used at some sacrifice of economy.

The Werdermann type of lamp is an instance of powerful incandescent lights. In this lamp the light is given by a short stout carbon rod raised to a white heat. One end of the rod rests against a carbon or copper plate, the circuit in the other direction being completed by conducting jaws through which the rod is forced as it consumes. This lamp is probably considerably more economical than gas from the high temperature to which the carbon is raised, the proportion of red and green candles being not very far from equal. It has also the advantage that a large number of lights can be burned in series without employing a machine of high electromotive force: for instance, in one

¹ This is also a feature of the Brush machines.

of these lamps which the writer saw tested, the current was about 30 webers, and the resistance of the light only about 0.17 ohm ; that is to say, there was a tension of about 5 volts between the ends of the light. This light measuring about 125 red candles and 145 green candles was, however, too powerful for common domestic use.

The smaller incandescent lights, the economy of which is not yet quite established, were exhibited by Messrs Swan, Lane-Fox (the Anglo-American Brush Co.), Edison, and Maxim. The incandescent substance in each case is a carbonized filament of some sort heated to a yellow heat in vacuo, and the main advantage will rest with the pattern which is longest lived. There was no opportunity of settling this question in the Exhibition, and it still remains open. Edison has, however, the advantage that his lamps have three or four times the resistance of the corresponding descriptions of the other makers, which enables him to work a larger number in divided circuit than they can ; he has also so arranged his lamp that it would be difficult for any one, when connecting it, to touch both wires at the same time ; by this means he diminishes the chance of a shock, &c. He makes lamps as small as eight candle power. Maxim endeavours to lengthen the life of his lamps by the substitution of gasoline vapour for the ordinary vacuum, asserting that the carbon under such circumstances increases rather than diminishes in thickness. As already stated, this theory has not been sufficiently tested.

As the light of these lamps approximates in colour to that of gas there would be no difficulty in comparing their illuminating power. In doing so, however, it is necessary to see that the current which is being passed through them is not stronger than that at which their endurance has been tested, for they can be made to give a white light amounting to as much as 1,500 candles (it is said) by the employment of large currents. They will only last a few moments at the high temperature required to give the large light just stated, and their life will be shortened below desirable limits by forcing them to give light which is not decidedly yellowish. The light of all these lamps is very steady and pleasant.

It is worth noting that Messrs. Swan prefer the alternating current for their lamps, believing that they last longer when fed by that current.

Accumulators.

Faure's accumulators were exhibited working Swan's lights and driving electric motors, &c. Without concurring in the sensational writings that have appeared from time to time concerning these batteries, one may fairly consider that, if it were not for their prohibitive price and weight, they would be very useful mediums for distributing electrical power. When it is considered that the cells cost 4*l.* a-piece, and that 25 (weight about 1,250 lbs.) is the smallest number admissible for a set of Swan lamps not exceeding say 18, it will be seen that they are not at present adapted for ordinary use.

The term accumulator is misleading, as the electricity which is passed into the reservoirs is spent in chemical changes, and the power which they afterwards furnish is due to fresh chemical changes. In fact they are a highly improved form of what have been long known as secondary batteries.

Messrs. De Meritens are also working at a secondary battery which would be much smaller in size, the positive pole consisting of an enormous number of lead foil sheets. It is to be hoped that this will answer requirements.

Very intimately connected with the question of economical electric lighting is the "Dowson economic gas," by the use of which in gas engines it is calculated that a saving of about 45 per cent. over other gas or steam engines is effected. If these calculations be correct, as it appears reasonable to suppose, it is probable that, even with the present form of yellow-light incandescent lamp, electricity would be a considerably cheaper illuminant than gas.

The Dowson gas, while suitable for heating purposes, or as an explosive, is

not directly suitable as an illuminant: it is made by passing superheated steam through red hot anthracite coal, and the gas as it passes into the reservoir is washed. It contains neither tar nor ammonia, and burns without smoke or soot deposit. Its composition is as follows:—

Hydrogen		20 per cent. by volume.
Carbon monoxide	C.O.	30 "
Bioxide of Carbon	C.	3 "
Azote, &c.	A ₂	47 "
		<hr/> 100

Ordinary gas is about five times as powerful and about twelve times as dear as the Dowson gas.

There was a very large amount of machinery of different kinds driven by electric motors, from the Siemens electric railway down to multitudes of sewing machines.

Sufficient experiments have not been made, so far as the writer is aware, to determine which are the best forms of motor. Either of the types of continuous current machines will furnish an efficient motor if a current of electricity be passed through it. One of the most remarkable was the Driscoll motor, which is a Gramme ring with a Siemens armature inside. This little apparatus only weighed two pounds, and worked with great force.

All the motors exhibited were worked by low resistance batteries. This is a decided drawback to their employment for domestic purposes, as such batteries require frequent making up, and the ingredients are corrosive or stain.

An account of the Exhibition should not omit to notice that most ingenious American exhibit, the apparatus for sifting "middlings," or in other words extracting bran from flour. The middlings are passed under a number of successive ebonite rollers, electrified by friction against wool; each roller extracts a percentage of the lightest bran from the heaviest flour, the former being deposited in a waste trough while the latter passes on for further refinement by the next roller. In the end the flour appears quite free from bran, and fetches the highest price in the market.

The Japanese produced arguments in favour of their view that there is nothing like paper, which they substitute for the brittle non-porous cells of ebonite and porcelain used by us.

Messrs. Siemens, of Berlin, exhibited a beautifully ingenious selenium photometer which gets over the difficulty of the comparison of different coloured lights by begging the question. Two pieces of selenium of equal resistances in daylight are connected with the coils of a differential galvanometer, and balancing pattern, and are then subjected to the actions of the two lights, one of which is kept stationary and the other moved until the balance is once more re-established. The process of measurement is thus made purely mechanical, which is an immense advantage, but as selenium resistance is unequally affected by different coloured rays, this system of measurement could only be adopted after careful trial. A point in its favour is that it gives the red rays the greatest value, thus as it were discounting the blue of the electric light. If a substance could be discovered which gives yellow rays the greatest value it would probably be a most satisfactory method of measurement.

Messrs. Dolbear have exhibited a telephone not noticed by the writer while in Paris, which appears to be the simplest invented yet. It might be described as a static telephone, as it dispenses with the magnets and electro-magnets hitherto considered essential, and retaining the portion of the apparatus hitherto deemed non-essential, namely, the diaphragms, produces its speech by variations in the electrification of two of these diaphragms placed close in front of each other.

There has been much discussion as to whether the sound of the ordinary telephone was due to vibration of the diaphragm or to molecular action in the electro-magnet, but all previous telephones which have been considered suitable for practical use have depended on variations of the dynamical electricity employed in working the electro-magnets used in the apparatus.

Fortunately, those to whom it was not convenient to visit the Exhibition at Paris will have an opportunity of seeing probably the greater portion of the apparatus at the Exhibition in the Crystal Palace which is about to open immediately.

NOTICES OF BOOKS.

An Outline of the "Attack Formations" for Infantry in the Austrian, French, German, and Italian Armies. Compiled in the Intelligence Branch of the Quarter-master-General's Department, Horse Guards, War Office. March, 1881. Pamph. Pp. 19. Sold by the principal publishers. Price 1s.

This very interesting pamphlet is illustrated by eleven plates descriptive of the text, and is to be commended to the perusal of all military men. We give *extenso* the summing up of the compiler.

"In the foregoing outline of the 'Formations of Infantry for Attack,' it is seen that a uniform type pervades the armies of the principal Continental nations, and that the same general principle serves as a common foundation for the whole. It is well therefore to note what this general principle is. Briefly it is:—

1. That the first, and perhaps the chief, part of every attack must be carried out by infantry fire.
2. That the final and decisive part of every attack must be carried out by the Shooting Line, reinforced by the reserves, who move in combination to the assault.
3. That the success of the final assault will depend on the effect produced on the enemy by the preparatory fire.

"Certain conditions are observable in the way this mode of attack is conducted. It is sought, in the first place, to gradually establish in the Shooting Line the number of men necessary to maintain the most effective fire against the enemy. It is at the same time sought to keep that number at the lowest that will be effective.

"The formidable objection to this class of 'fighting formation' is the dispersion of the troops in the first line of battle it entails. This disadvantage is so fully recognized that every precaution is taken to diminish as far as may be, and for as long as possible, the extent to which that dispersion is allowed to take place. But the necessity for this dispersion, in order to obtain an adequate degree of fire, and at the same time to lessen sufficiently the extent of target offered to the enemy, is now universally, however reluctantly, admitted and accepted by Continental nations.

"Accordingly we find that, in the 'Regulations' of these different armies, a very small fraction of the force to be engaged is first extended in the Shooting Line. When a Battalion is to assume the 'Attack Order,' the Germans extend, in the first instance, two half-zugs (subsequently reinforced by the remaining half-zugs) or a twelfth part of the Battalion. The French extend two sections or an eighth of the Battalion. The Italians likewise extend two sections, also an eighth of the Battalion. But the Austrians allow great discretion to the Company Commanders as to how many men he will extend in the first instance. Here is visible from the outset a close adherence to the principle that is at the root of all power in battle, *i.e.*, the keeping intact and under control the largest possible part of your force and for the longest possible period.

"But a closer examination shows that the above disposition must be regarded rather as a preliminary formation previous to attack than as the actual 'Attack Order.' It is more a precautional order of advance towards the enemy's position previous to carrying out the actual attack. Here it is to be noted that though there is in this a great similarity to that of the old skirmishing line covering the advance of a body of troops in close order, yet the analogy quickly ceases. The business of the old skirmishing line was the minor one of clearing the front of troublesome sharpshooters of the enemy, and then giving way for the main body to move forward and attack the position with the bayonet.

"Now, however, the preliminary skirmishing line is the nucleus or skeleton of what is to become the Shooting Line in the attack. It is taken from those companies which are to form, in the first instance, the front line of battle. This line is never meant to retire or be replaced by other troops, but it is to be reinforced as required, and it is ultimately to form part of the body to storm the position.

"The rules for extension in the first instance simply establish a precautionary order of advance, for it is admitted that when the real attack commences, the Shooting Line should be at once reinforced up to the full number of rifles that can be effectively used.

"In carrying out an attack on this principle complete uniformity in the order of battle adopted may be said to exist amongst Continental nations, the differences being unimportant and only of detail. The first line of battle is subdivided into two main groups—

1. Fighting Line { Shooting Line.
Supports.
2. Reserve.

"These are, as a rule, furnished by the same tactical unit.

"A battalion in the first line of battle has in—

Fighting Line.....	$\frac{1}{2}$ battalion.
Reserve	$\frac{1}{2}$ battalion.

"The Austrians and Italians subdivide the Fighting Line into—

- | | |
|---------------------|------------------|
| (1.) Shooting Line. | } Fighting Line. |
| (2.) Supports. | |

"The Germans and French subdivide it into—

- | | |
|----------------------|------------------|
| (1.) Shooting Line. | } Fighting Line. |
| (2.) Reinforcements. | |
| (3.) Supports. | |

"This subdivision was probably originally adopted by the French from the Germans. But recent French writers of authority strongly advocate the combination of the Reinforcement and Support into one body, and the subdivision of the Fighting Line into two parts.

"The peculiar formation of the German company may, perhaps, account to some extent for the order adopted in that army.

"The normal formation of the German company is in three ranks, but for fighting order this formation is abruptly changed into two ranks. The normal subdivision of the company is into two parts called zugs, but when it changes to two ranks from three, the whole of the rear rank forms a third zug. The zug is held to be so important a fraction that the whole battalion is numbered by zug from one to eight. But when the alteration from three ranks to two takes place, numbers have to be provided for the four fresh-formed zugs, which strangely enough are numbered again from one to four.

"This parade order in three ranks which is never used in action, and this duplicate numbering of sections of companies, would be probably regarded as both clumsy and confusing if practised by any other nation than the Germans.

"This formation constitutes for the Company three distinct units. Consequently (on the principle of keeping units distinct and intact as long as possible) when a Company in the first line of battle takes 'attack order,' one zug is extended, one advanced as a first support, and the third kept back as a second support or imme-

diate reserve. But it is quite possible that the order is made more to conform to the subdivision of the Company than from any advantage derivable from three lines over two.

"As regards the extent of front first occupied by the 'Shooting Line' of a Battalion a good deal of uniformity exists.

"The two half-zugs first extended by the Germans cover only a space equal to half the Battalion deployed. But as soon as the remaining half-zugs are moved into the Shooting Line a front equal to the whole Battalion deployed is occupied. Similarly the Italians occupy in the first instance only a front equal to half the Battalion deployed, but according as the Shooting Line is reinforced it is extended to a space equal to that of the whole Battalion deployed.

"With the Austrians and French great latitude is allowed in the preliminary extension of the Shooting Line, but it is laid down that when this line is completed for attack the front occupied should also be that of the Battalion deployed.

"With regard to the Shooting Line, there is an agreement of opinion in favour of working by groups.

"In the German Army each extended section of a company forms a fire-group. It is under the command of a non-commissioned officer, and it is separated by an interval from the group on either side.

"In the Austrian Army a similar system prevails, and from the latitude allowed, would seem to be carried even further. The squads or groups form loose links of a general chain which has a given extent of front to cover. But within that front, while maintaining the general direction of advance, great freedom is allowed them. They look immediately to their own squad leaders for orders and guidance, and they are allowed to move either closed in a body, or in extended order, as the ground and situation may determine.

"In the French Army the Shooting Line advances, in the first instance, in a line of squads, grouped separately. They retain this order until the enemy's fire checks the advance, when they extend.

"Similarly in the Italian Army, squads are preserved and kept apart by intervals varying from two to six paces.

"There is some divergence in the different armies regarding the places taken by men of each file within the groups.

"The Germans require the two men of a file to be close together, but they may be either side by side or one behind the other.

"In the Italian Army the rear rank men are directed to move up and align themselves with their front rank men at not more than one pace interval.

"In the French Army the rear rank man is required to come up on the left of his front rank man immediately the extension takes place.

"Similarly, the intervals allowed between the men in the Shooting Line also vary. The Germans make the intervals first taken dependent on circumstances at the moment, but limit the extent to six paces.

"In the Austrian Army the Captain of the company is informed of the extent of front he is to occupy, but the manner of extension is left a good deal to his discretion. He is bound, however, to be guided by the rule that, when the Shooting Line is fully formed, each man in it should be allowed about two paces. The Italians allow three paces between files, while the French allow six paces in the first instance, diminishing the distance afterwards.

"As regards the distances between the different bodies behind the Shooting Line, and their position with regard to the latter, it will be observed that a good deal of difference exists, and that as a rule great latitude is allowed. The Germans object to laying down fixed rules for distances between lines. They work on the principle that behind every extended line there should be a closed body near enough to give timely assistance, but, if possible, not exposed to the same fire. Though in the other armies certain distances are given, it is provided that they are not to be considered binding; while the positions to be occupied by supports and reserves are left entirely to the discretion of the commanders of these bodies.

"The general method of advancing to attack is pretty uniform in these armies, but it may be well to notice the manner in which reinforcements are made to the Shooting Line.

"The Germans and Italians appear to attach great importance to the bringing up reinforcements on the flanks of the extended line, rather than in the intervals between its files. This mode of reinforcing they regard as the rule, though circumstances may in special cases require it to be departed from.

"The French and Austrians, on the other hand, do not appear to lay such stress on this mode of reinforcing. All agree, however, on the principle at stake, *i.e.*, that all reinforcing bodies should be kept as far as possible intact. Further, that all reinforcements should be made by regular units (sections, zugs, &c.).

"The bringing up of reinforcements on the flanks of extended bodies tends more than any other method to the prevention of mixing of different units. The practical action of an extended line in action is to close on its centre. The casualties caused by fire thus leave gaps on the flanks. If, therefore, successive reinforcements can be brought up on the flanks, the mixing of different units would be avoided. And this mixing of different tactical bodies is one of the great evils of the extended order of fighting.

"On the subject of reinforcement a clear distinction should be drawn between the mode of action in this respect of the 'Supports' and of the 'Reserve.' Taking a battalion as the foremost fighting body in the line of battle, formed as—

- (1.) Shooting Line.
- (2.) Supports.
- (3.) Reserve.

"The mission of the 'Support' is—

- (1.) To feed the Shooting Line according as gaps are made in it by casualties.
- (2.) To give a moral support to the Shooting Line by being close at hand.
- (3.) To act as occasion may require in covering the flanks of the Shooting Line or meeting attacks of the enemy.

"But the ultimate mission of the supports is, it may be said, to be absorbed in the Shooting Line in extended order.

"But action of this kind is not what should be aimed at in the Reserve. Though its connection with the Shooting Line and supports is of the closest kind, and its mission to afford the most direct support to the bodies in front, yet its intervention, when the time comes, should be sought to be made without allowing its companies to become extended in the Shooting Line. The order of dispersion is, for all purposes except fire action, an order of weakness. The efforts of the commander must be strained in keeping intact, up to the last, as large a part of his force as he can. Hence, when the reserve is brought forward for the final stroke, it should be engaged in such order as will, when the assault has been delivered, admit of the commander having some portion of his force under immediate control. Therefore, the reinforcing of the extended line by the Reserve should not, if possible, be carried out in extended order, but rather by companies in line, or such other compact formation as the ground and circumstances may admit of.

"In case of a reverse or serious check in an attack, the extended order contains every element of danger; and having a formed body of troops well in hand, however small the number, to make a temporary stand with, and enable the rest to rally, is of extreme importance. Hence this principle of bringing the Reserve into action as a closed body when possible is to be strongly inculcated, as is also that of on no account using up the whole of the Reserve until fresh troops arrive to take its place.

"Therefore we find that, when a company is acting singly, it is required to keep at least one section in close order as a Reserve. Similarly, a battalion should keep at least one-fourth as a Reserve.

"It is not to be inferred from this that a whole battalion is never to be extended in the Shooting Line. It may frequently occur, when a considerable force is engaged, that the enemy's resistance has so weakened the attacking force, that it becomes necessary, in order to keep the fire of the Shooting Line effective, to extend the whole of the companies of the battalion. But in this case there would be fresh troops in rear to form a new Reserve, to whom in turn the above principle would equally apply."

Tactique de Combat des Trois Armes. Par Le Lieutenant-Général BRIALMONT. Brussels, Leipsic, and Paris, 1881. Pp. 730 and 9 plates. Two volumes and atlas; price 15 francs. Size together $8'' \times 5\frac{1}{2}'' \times 2\frac{1}{4}''$. Weight under $3\frac{1}{4}$ lbs.

THIS well-known writer and distinguished engineer, using as a foundation his "Études sur les Formations de Combat de l'Infanterie, l'Attaque et la Défense des "Positions et des Retranchements," published in 1880, and specially intended for Officers of that corps of which he is so eminent a member, now appears as an exponent of the tactics of the three arms. The work contains a great amount of valuable information, and is up to the latest date; it is further a most useful addition to tactical literature, as meeting the want which is keenly felt at the present moment of some work, on not too large a scale, which shall place the reader *au courant* with the state of tactics in the year 1881, and serve as a point of departure for closer study of the subject and its future development.

The work opens with some excellent general considerations on the Organization and Tactics of Infantry, and the author recognizing the logical necessity that, since tactics depend on the arms in use, a knowledge of the power of the latter must precede any discussion of the former, gives the results most recently obtained in target trials of infantry fire; and then from these and the experience gained in modern campaigns he draws a series of conclusions, which, in the opinion of the author, should form the basis of the tactics of to-day. The normal formation of a battalion for combat is treated fully and impartially, the General fully recognizing, as he states in his introduction, the great diversity of opinion which prevails on the subject. Three chapters are devoted to the questions connected with infantry fire, and here, as throughout the work, the practice followed in the principal Continental armies is fully brought before the reader. The formations of infantry in attack and defence, from a battalion up to a division, are thoroughly explained. In considering the mode in which a position is to be occupied and held, General Brialmont energetically combats, we are glad to see, the tactical heresy which appears to be finding support in some quarters, that the crest of a hill is, as a position, inferior to a line taken up on the plateau in rear. The application of the principles enunciated to a given site, and the attack and defence of entrenchments, conclude the first volume.

In the second volume we find Tactics of Cavalry, and the fighting formations of this arm from a regiment up to a division: the service of *Exploration*, the organization of Cavalry Pioneers. Artillery are dealt with in this volume, of which the last section comprises outposts, orders of march, and fighting formations of a division and of a corps d'armée. The numerous Appendices form also a very valuable part of the work. We have much pleasure in strongly recommending this work to military men, especially to those who feel that their knowledge is somewhat behind the times.—L. A. H.

Rôle de la Fortification dans la Dernière Guerre d'Orient. Par J. BORNECQUE, Capitaine au 1er Régiment du Génie. Paris: Dumaine. 1881. Size $9'' \times 5\frac{1}{2}'' \times 3\frac{1}{4}''$. Pp. 377. Weight 1 lb. 6½ ozs. Price 7 fr. 50 c.

GRADUALLY instalments of military researches in connection with the war of 1877-78 are being produced, all giving us, with regard to that struggle, more or less information concerning details, without which knowledge the study of any campaign is rather an intellectual exercise than a lesson of war.

In this publication are gathered together those episodes and details which belong to the province of fortification, both permanent and field. At the commencement Captain Bornecque very justly deprecates the practice of forming hasty conclusions from imperfect data, and it is his endeavour, drawing on a large number of writers, not only to sift the true from the false, but to reconcile the apparently contradictory results of a strong fortress falling easily whilst improvised field works frequently hold out a long time.

Captain Bornecque endeavours to show that field and permanent fortifications alike have their value, and he makes the just remark: "In one word, if Generals "have made mistakes where fortresses are concerned, the blame must rest with "them and not with fortifications."—L. A. H.

Horses and Stables. By Major-General Sir F. FITZWYGRAM, Bart. London: Longmans. 2nd edit., 1881. Size $8\frac{3}{4}'' \times 5\frac{1}{2}'' \times 2''$. Weight under $2\frac{3}{4}$ lbs. Price 10s. 6d.

THE author of this important work combining in himself the qualifications of Inspector-General of Cavalry and ex-President of the Royal College of Veterinary Surgeons, his treatise, as might be expected, is a thoroughly practical and trustworthy guide on all the subjects discussed in it, and is in fact just the sort of book that the military Officer who is interested in horses and their management would like to have at hand. While giving the fullest and most accurate account of the present state of veterinary science, it is withal written in the plainest language; technical terms being very properly used, but at the same time clearly explained.

The first part treats of the ventilation and construction of stables, stable fittings, watering and feeding, forage, grooming, exercise, and stable management. This portion of the work is most valuable, especially perhaps the chapter on forage, which is full of useful information to horsekeepers, and illustrated by numerous plates, showing the various kinds of grasses, "herbage," and weeds to be found in the different descriptions of hay. This part is especially worthy of perusal by the Staff Officer.

Part II exhibits principally what may be called the "Institutes of Veterinary Medicine," giving in plain and yet scientific language just so much account of the structure of the horse's frame and tissues, and the action of the different organs, &c., as is requisite to enable the general reader to understand the difference between healthy and diseased action in the various parts of the body, and the action and uses of medicines. The remaining parts of the work treat of diseases and accidents in detail; the symptoms of diseases are explained in clear language, and the treatment suggested is as clearly described. Chapter LX contains a very useful account of the conformation of the horse, and those who wish to know all that can be said about "form" and "points" cannot do better than read pp. 576 to 618. Not the least valuable part of the book is that devoted to the feet and shoeing, the chapters on this head having been added to the present edition from the author's valuable "Notes on Shoeing."

The amount of practical information scattered up and down the work is very considerable, and it is amply illustrated with well-executed plates.—C. W. B. B.

La Guerre d'Orient en 1877-78. Étude Stratégique et Tactique des Opérations des Armées Russe et Turque en Europe, en Asie, et sur les Côtes de la Mer Noire. Par un Tacticien, Auteur de Plusieurs Ouvrages Militaires. Ouvrage rédigé sur les Documents Officiels. Paris: Dumaine. 1879-81. En plusieurs fascicules. Size of each, $10'' \times 6'' \times \frac{3}{4}''$. Price of each part, 5 fr.

THE author of this work honestly admits that a thoroughly full account of the war of 1877-78 could come only from the Russian Staff. He has, however, made use of all official documents accessible and of the accounts published by non-official observers since the war. The result of his labours, which, in the six parts published to the present date, are given to the European campaign alone, and carry this down to the fall of Plevna, is very satisfactory. The work is fully illustrated by admirable maps, plans, and sketches, and the price of each instalment is low enough to be within the means of most military men.

The gradual issue of the work naturally tends to increase the value of each succeeding part of it, inasmuch as with time increase the number of independent criticisms, and accounts of the campaigns. Even should hereafter the Russian Staff publish their official account of the war, they will not give to the public the same amount of unbiassed criticism that is being bestowed on it by the anonymous, but thoroughly competent, writer of "*La Guerre d'Orient.*"—L. A. H.

Réorganisation Militaire. Fortifications, Chemins de Fer. Par LEOPOLD BRESSON. Paris: Dumaine. 1881. Pamph. Pp. 49. Price 1 fr. 50 c.

THIS is an interesting little pamphlet, in which the writer briefly reviews the measures of reconstruction of national defence carried out by the French Government since the war of 1870-71. He describes succinctly the means adopted for strengthening the frontiers by the construction of fortifications and of strategic lines of railway, and calls attention to the necessity of working out in peace time all those details connected with the transport of troops in time of war. The pamphlet is well worth perusal by those who wish for a brief summary of the defensive power of France at the present moment.—L. A. H.

The Equipment of Field Artillery. By Captain J. R. J. JOCELYN, R.A. (the R.A. Institution Gold Medal Prize Essay, 1881). Printed in the "Proceedings R.A. Institution," No. 7, vol. xi.

MUCH of this essay is necessarily technical and not of interest to general readers. Putting then aside these portions of the essay as beyond the scope of this notice, we note that whilst Captain Jocelyn advocates the introduction of breech-loading guns, he omits, as one of the grounds of superiority of breech-loaders over muzzle-loaders, that very important feature, the lessening the exposure of the gunners to infantry as well as to shrapnel fire, and this although he is warmly in favour of providing field guns with shields, an innovation already brought forward by a well-known gunner for acceptance. We who are not gunners want to have the advantage of artillery support in action up to the last moment; and we believe that, from a common sense point of view, he who goes in front of the muzzle to load runs a greater risk than he who stands behind the breech, particularly in such cases where the guns are so favourably posted that only the muzzles peer over the edge of the hill. We should like to have seen in this essay a definite solution of the problem of providing artillery with an explosive shell that will really be effective against parapets, and also an incendiary shell, without which artillery is next to powerless against troops judiciously posted in villages. We are glad to see Captain Jocelyn is a believer in the value of a machine-gun, such as the Hotchkiss, as part of field artillery equipment.—L. A. H.

Conduite d'un Escadron de Contact. By R. DE BIENSAN, Captain 3rd (French) Cuirassiers. Paris: Dumaine. 1881. Price 5 fr. Pp. 206. Size 9' x 5½' x 5/8". Weight under 15 ozs.

ALTHOUGH of an elementary nature, this is one of the most interesting works on Cavalry that has appeared since the celebrated Part II of Verdy du Vernois' "Studies;" and, unlike the latter, it is a book which can be read without requiring much mental exertion. The scope of the work may be gathered from the following extract from the preface:—"The present work has no claim to novelty. It is evident that its spirit, method, and form are borrowed from the works of General Verdy du Vernois; but let not the reader accuse me of having attempted to make a *réchauffé* of his work; a masterpiece does not admit of being hashed up again; moreover, my aim has been far less ambitious." "Though the General might well be justified in tackling problems on a grand scale, a becoming modesty compelled me to aim at a much lower mark. I have attempted to work out for a squadron what he has done for a division, thus bringing the tactical horizon within the limits of a less extended range of vision."

The plan of the work is as follows:—An episode, partly real and partly imaginary, of the Franco-German War of 1870-71 has been taken as the groundwork, and the writer describes in an interesting narrative the details of work performed by a squadron detached from a German cavalry division in advance of the 3rd Army, following up the mass of the enemy, which is supposed to be retreating from the east towards Chalons. The mission confided to this squadron extends over five

days, and the author manages most skilfully to introduce into a personal narrative of the doings of the contact squadron as much instruction in details as can well be imagined. Three excellent maps, extracted from that of the French Staff, accompany the work, and by their aid the working of all the detachments described in the text can be easily followed. It would be almost impossible to give anything like an intelligible *précis* of the book, as in order to be understood it must be read with the map opened before one. Suffice it to say that in each day's work several sound practical lessons are inculcated, and, what is more important, illustrated by concrete examples which cannot fail to interest the reader, and so are calculated to make a lasting impression on the mind. The various motives which might be supposed to be working in the squadron leader's mind at different critical junctions are brought vividly before the reader, and the *pros* and *cons* of each case carefully weighed.

No doubt many decisions are arrived at which everyone will not consider to be the wisest; but the author's object is, above all things, to induce the reader to think for himself. Thus, in his preface he says: "It is unnecessary to say that the proposed solutions of the various problems are not proof against criticism. On the contrary, my attempt will have attained its end, and I shall consider myself only too happy to have made it, if it be fortunate enough to provoke discussion, and if a comparison of the opinions then expressed were to induce competent authorities to establish certain points which are yet undecided."

After bringing the squadron back to the division on the completion of its mission, the author draws a few general conclusions on such subjects as "Map reading and knowledge of languages," "The transmission of despatches," "The rôle of Staff Officers in connection with strategic reconnaissance," "The most suitable strength of a reconnoitring detachment;" from which we select the following as a specimen:—

Transmission of despatches: "Notwithstanding all that we have just said, it is not in the resistance of the enemy, nor in the want of maps, nor in ignorance of the language of the country that the chief difficulties are to be found.

"Somehow or other, in spite of all obstacles, a bold Officer will generally manage to reach the ground assigned to him to explore. With activity and address he will even succeed in gaining important, if not decisive, information. We grant all this. But, in our opinion, the greatest and chief difficulty, for the success of the mission mainly depends upon it, is the transmission of his despatches. We lay great stress on this point, because of all the schemes for organizing the service of exploration, those especially which recommend pushing reconnoitring squadrons far in advance seem to have been but little concerned hitherto with the solution of this problem.

"It is not simply necessary to gain information; it must be transmitted. In a friendly country, or when the reconnoiters are linked to the main body by connecting posts, the thing appears easy enough; but in the enemy's country, if the reconnoitring bodies have become completely detached from the division, the difficulty begins as soon as some 15 or 20 kilometres¹ have been attained, and increases with the distance.

"To begin with, let us lay down the principle that it is useless in such a case to think of organizing relay posts for transmitting correspondence. The thing is physically impossible, for the simple reason that neither the main body of the division nor the detached squadron is in a position to provide them. Indeed, in order to organize these connecting posts three conditions are necessary. First of all the point from which the chain of relays is to start, and that to which it is to extend, must be known; secondly, there must be the possibility of relieving them and rallying them on their corps; thirdly, they must not be exposed to capture by the enemy.

"Now if the division is in the marching stage of operations, and in the enemy's country, none of these three conditions will be fulfilled. Both the division and the squadron are liable to move; and the position of their objective, the enemy, is equally unstable. Their routes, being dependent on the movement of the enemy (that is on the unknown), are essentially variable, irregular, impossible to foresee from one day

¹ 1 kilo. = $\frac{2}{3}$ English mile.

to another. One cannot, therefore, know beforehand either where the chain will commence (the main body of the division) or the point to which it is to lead (the reconnoitring squadron). It would be just as possible to draw a geometrical line between two unknown points x and y .

"But supposing the problem to have been solved by chance; that is, suppose that the chain has been extended and the posts fixed. This is all very well for to-day, but what about to-morrow? To-morrow the division will shift its position, and the squadron too. How, then, is the position to be re-established?

"Again, whether your posts are furnished by the main body of the detaching force or by the detachment itself, how will you relieve them? When you leave them, where will you tell them to rejoin, not knowing yourself where you are going? Of course we are here supposing a distance of 30 or 40 kilometres, which require at least four or five hours for an order to traverse the whole length of the chain. We are also supposing that the division does not know where the enemy is; it is seeking and groping about for it; its march, therefore, is uncertain, being guided solely by the ever-varying reports of the patrols. Under these conditions we assert that connecting posts will never be relieved with precision. They will be forgotten and go astray, and their despatches with them.

"We, therefore, inevitably arrive at the conclusion that the establishment of a chain of relays 10 leagues long is impossible in practice in an enemy's country. In rear of the cavalry division, to connect it with the corps d'armée, it will perhaps be feasible to organize one; but in front of it, in the direction of the contact squadron, it is useless to think of it.

"The preceding discussion will appear superfluous to some readers; but the theory of connecting posts still counts so many partisans that its absurdity deserves to be exposed.

"We would add that we have but little confidence in the trustworthiness of this mode of proceeding. In our opinion a despatch which is confided to the responsibility of a single person is much safer than it would be if it circulated from hand to hand, under the anonymous responsibility of a chain of relay posts.

"The system of connecting posts as applied to the case in point being impracticable, and even dangerous, let us search for something else.

"Some authors recommend the employment of the telegraph. This certainly appears tempting, but is, unfortunately, open to many objections. In the first place, Officers must know how to manipulate the instruments, which is but very rarely the case in our army. This is another branch of military education which is still too much neglected, and to which it is expedient to draw the attention of the authorities. Strictly speaking, a mounted telegraphist would be attached to the party. But one is apt to forget that most frequently a reconnoitring Officer will be ordered to cut the telegraph, as happened in the preceding study.

"Moreover, in an enemy's country, the telegraph is an unfaithful messenger; despatches are liable to be intercepted, mutilated, and altered. Still it is an auxiliary resource, which must not be rejected in principle, but care must be taken that it is only used under fitting circumstances. When employed, the Staff must let it be known to what telegraph station the division is attached, and to it the reconnoitring Officer will send his despatches.

"But owing to the uncertainty of the telegraph it is essential that a reconnoitring Officer should never be satisfied with a telegram for the transmission of important news. He ought always to send a duplicate of such a despatch by a messenger. It would always be prudent to send certain despatches in cypher, for which purpose the plan indicated by General de Brack would be found useful. It is the most convenient and the most rapid cypher, and perhaps the only one which is illegible by anyone who does not possess the key.

"Leaving exceptional modes of communication out of consideration, there remains but one normal mode of insuring the transmission of despatches, viz., to send messengers as Captain A . . . did.

"It may be asked whether it is better to send them on horseback or in carriages. Certainly, when the distance is not too great, and the horses are not too much fatigued, the former method is to be preferred; it entails fewer complications, a man on horseback is freer in his movements, and he can pass where a carriage would

be stopped. But if the horses have already covered 12 or 15 leagues, and a despatch has to be sent 30 or 40 kilometres in the evening, there is great fear that it may not reach its destination. Some horses are able to make such a journey, but not all. This opinion will not sound strange to those who consider the average condition of a troop horse, the enormous weight it carries, and the irregular nourishment it receives.

"But other considerations come into play. In an enemy's country a solitary horseman is continually exposed to being shot. His uniform and his isolation point him out to the vengeance of the inhabitants. It will, therefore, often be advantageous to disguise the bearers of despatches. But a man on horseback, even if disguised, will always arouse suspicion.

"For these reasons, then, it will be often preferable to send messengers in requisitioned carriages. The German Staff Officers travelled in this way, with their horses tied to the back of the carriage. This method combines many advantages, but we fear that it could not be easily adopted with our horses, as many of them would pull backwards and cause great embarrassment. The plan must be tried before pronouncing a final opinion on it. Meanwhile it appears to us to be simpler to leave with the squadron the horse of the man who is taking the despatch. It would then be led, and in case of need could temporarily replace the mount of another man which might have been knocked up."—C. W. B. B.

Instructions for the Training, Employment, and Leading of Cavalry. By Major-General Carl von Schmidt; translated for the Intelligence Branch by Captain (now Major) C. W. BOWDLER BELL, 8th Hussars. 1881. Price 3s. 6d. Size, 10" x 6½" x ¾". Pp. 232. Weight 1 lb. 2 ozs.

THIS is a translation of the greater portion of the "Instructionen" of Von Schmidt, who, as stated in the translator's preface, was commonly considered the most able cavalry commander that Prussia had seen since the days of Frederic the Great. His influence on the cavalry service of his country was undoubtedly greater than that of any other man, and the admirable Cavalry Regulations of 1873, so simple and yet so complete, were in great measure due to him; but the world-known revised Part V of those Regulations, drawn up by a Committee, of which he was president, and issued in 1875, will probably form the most lasting monument to his memory. As a matter of fact, Von Schmidt never did write the "Instructions" imputed to him. They consist really of extracts from various materials left by him in the form of MS. notes, and his officially issued orders and circulars, and were compiled by Captain von Vollard-Bockelberg (for many years Von Schmidt's Adjutant), by order of Prince Frederic Charles. The original work abounds with repetitions, as might be expected from the nature of its origin, and moreover contains much that would not be of interest to the general cavalry leader; but the translator has exercised his judgment in omitting such sections as seemed quite inapplicable to the British Service, and the result is a compilation, every word of which may be read with advantage. A very important addition has been made to the English translation in the shape of plates taken from the German Regulations, and indeed without these aids the work would have lost most of its value for our cavalry; if the book be carefully read with the assistance of these plates, our Officers ought to have no difficulty in mastering the fundamental principles of German cavalry drill.

The work is divided into six parts. Part I treats of the general principles of training and employing cavalry, and brings to notice some very interesting extracts from the Regulations of Frederic the Great (issued in 1743). It may be questioned whether many Officers have very seriously realized what the great King expected of his cavalry. Thus in his instructions for spring drills in 1755, he directs: "On days when there is no drill, the whole regiment must trot at first 1,000, then 2,000, 3,000, and 4,000 paces. When the horses are thus in wind they will not be blown in the charge, will not break down, nor become sick when subjected to fatigue. We may expect to have to gallop at 1,200 or 1,500 paces from the

"enemy, and to charge for 400 or 500 paces ; it is not enough to overthrow the first line, but the enemy must be followed up so that the first line may be hurled back on the second and throw it into confusion." Again, at the reviews before the Seven Years' War, the cavalry executed gallops of 2,000 or 3,000 paces, and often repeated them at once.

Frederic laid great stress on the necessity of cavalry rallying with the greatest possible alacrity after the charge, and Von Schmidt particularly insists on the frequent practice of this exercise.

Part II deals with the training of the squadron, that is, the individual instruction of man and horse, and the drilling of the squadron as a whole. Those who have seen and studied the working of the German cavalry will know that the main excellence of it consists in the marvellous accuracy with which squadrons are manoeuvred : movements which at first sight may appear somewhat complicated and critical (such as those in half-column), being performed with a precision that may be called mechanical. Von Schmidt lays down that the foundation of all cavalry drill is "rhythm," or rate of pace. "The times laid down for the different paces must be accurately adhered to in all evolutions, without the slightest variation. There must be no dressing by eye when in movement ; it must be kept entirely by riding straight at the proper pace, and by feeling. Where everyone rides at exactly the same pace, there is good alignment ; but where men dress by the eye we see only individual riders and constant checking and hurrying up, which ruins the horses. Only at the halt should there be dressing by the eye, and even then it should be more from the front, in the way of distance, than to a flank." "The rate of pace of the trot and gallop should be perfectly known by all, and it should become a second nature to every man to feel the pace." "Alignment depends entirely on this, that the horses are square to the front, that light touch is maintained between neighbouring files, that the front rank maintains two full paces distance from the zug-leader, &c." "Everything depends on the zug-leader, and the men must be educated and habituated to follow him blindly, wherever he may lead them." This principle of dressing by the front and not to a flank, and taking the direction solely from the leader, is the very foundation of the German system of drill, and diametrically opposite to our principle of dressing by a point in the ranks. The remainder of this part of the book consists of detailed directions for wheeling, movements in line, breaking into column and half column, &c., and the manoeuvring of squadrons, singly and against each other.

Part III embraces the instruction of the regiment in field movements, and with the assistance of the plates extracted from the German Regulations, the most important movements can be easily understood. Von Schmidt lays it down as the essential principle here, that "*the squadron must be considered as the independent tactical unit*, and there should not be a too rigid observation of the intervals between squadrons." "The squadron-leader, when working in regiment, does well to think that he ought to keep near the next squadron, so as to preserve the cohesion of the whole, but this should not degenerate into over-anxiety about preserving the regulation intervals. If each squadron marches in the general direction there will be no necessity for any inclining." "Even at the halt, it is contrary to the cavalry spirit to correct too large intervals by the flank march of threes, or by inclining : it is much better done by command of the squadron-leader while advancing or retreating." Two other points strongly insisted on by Von Schmidt are the independent riding of the rear rank, and the principle of squadrons, in all movements by oblique directions, taking always the *shortest route*, and making use of the *simplest evolutions*. Great stress is laid upon the rule that, in forming line from columns of any sort, squadrons should be formed first, and from these the regiment, so that a front may be formed as rapidly as possible, though it be but in echelons.

Part IV deals with the larger tactical bodies, the Brigade and Division. This portion of the subject is considered under the two heads of "Deciding Tactics," or the employment of cavalry as an independent corps in the line of battle in combination with the other arms ; and "Detached Duties of Cavalry." Under the first head we have the fullest, indeed, we might almost say the only available, instructions for the working of cavalry in three lines. As the necessary preliminary to this mode of

employing cavalry, "the men, both in squadron and regiment, must have acquired the greatest certainty and calm in movements in line at full gallop, and keep their compact formation in two ranks." "The greatest pains must be taken to acquire the long, regular, quiet gallop. This is a necessity, if we would fulfil the conditions that the battlefield now requires of us; for it is only at this gallop that we can ride through the effective fire zone, if we would keep the necessary compactness of the line, and would not arrive at the enemy in a decimated condition." "The compact, rapid charge, without depth, must be a matter of ordinary occurrence on the drill ground; for then only can it succeed in reality. *Only that should be attempted before the enemy on the field of battle to which the squadron has been accustomed in time of peace, and which has become as it were ingrained in their flesh and blood.*" "Mobility, rapidity, and manœuvring power should not be diminished by the fact of working in large masses; brigades and lines should move with as great rapidity and certainty as isolated squadrons, and this can very easily be attained if the true principles are complied with, and have become second nature. These depend on uniform, steady riding, without any checking or rushing, that is, on *pace*, also on the *maintenance of direction, rapidity in taking new directions*, and lastly, *thorough independence of squadrons as the tactical units*, no attention being paid to the momentary aberrations of neighbouring squadrons, and the leader really leading his squadron." "The fundamental principle of the tactics of lines is organization in the direction of depth, mutual assistance from the rear, concentrated energetic action of the mass on a decisive point; no lateral extension of front; no eccentric or divergent operation of the component parts, unless it be rendered absolutely necessary by circumstances; no putting forth of the whole force at the same moment, but always keeping an intact portion in hand." "The principle of Frederic the Great must be strictly carried out; *the attack must always be directed against the weak part of the enemy; against his flanks; whenever possible, the front and flank of the adversary's cavalry should be attacked simultaneously, and his rear too, if it can be done.* The great King frequently asserted that *three men in the rear do more than fifty in front.* During the attack, then, we should still continue to manœuvre and work against the enemy's flank, to which end we may employ movements in half-column (gaining ground to front and flank), and changes of direction. *The shock should always come from a direction different from the original one*; this must be the rule, and should have become second nature to the troops." Then follow detailed directions for the working of three lines, the execution of the attack, pursuit and rally, and a short chapter on the employment of the horse artillery of the cavalry division. Under the head of "Detached Duties of Cavalry Division" may be found much valuable instruction in screening and reconnoitring duties. Part V treats of dismounted service, and is well worthy of study. The following extract will show what Von Schmidt's views on this subject were. "If cavalry is not able to fight effectively on foot under all circumstances, it is not up to its work, and is not worth the sacrifices that the State makes to maintain it." "When, owing to circumstances of ground or to the enemy's occupation of localities and defiles, it is not possible for cavalry to attain its object on horseback, when it is very difficult to turn such places, when nothing can be hoped for from mounted action, and there is no infantry on the spot, nothing remains to cavalry but to dismount, to open the way by an attack with carbines on foot, so as to gain its object." "It is not our place to stand fast under fire in positions under cover; our object must be to approach the enemy and dislodge him." "The main thing is to carry out the mission in hand at any price; if possible, should be done mounted, and with the *arme blanche*, but should not that be feasible, then we must dismount, and force a road with the carbine." "Independent and successful action of cavalry divisions is not conceivable unless such cavalry is capable of maintaining a combat with firearms, offensive and defensive, by whole regiments, either for the attack of localities, or for the defence of their cantonments." "All our efforts should tend to bring us as nearly as possible on a level with that period of cavalry history when it had attained a point of efficiency and *éclat*, and that has not been again reached." "In this glorious period (that of Frederic), cavalry lost nothing of its true spirit; they did not forget to charge with the *arme blanche*, although they had much

"more training in fighting on foot than now-a-days, and had very frequently to obtain their successes by fighting in that manner."

Part VI is devoted to the details of "Field Service," viz., advanced guard, out-post, and patrol duties, and many valuable hints may be culled from this portion of the work. Thus, after deprecating the tendency to reduce the instruction in these duties to a number of hard and fast rules to be observed in all the various cases which may arise, and after laying down that merely general guiding principles should be taught the men, and their individual thinking powers developed as much as possible, Von Schmidt's observes: "By proceeding in this way, generalizing instead of specializing everything, the ordinary run of men will be brought to think and reflect much more than they would be by going through a host of particular cases with them, and laying down what they ought to do in each instance. Owing to the endless combination of circumstances that may occur, it would be impossible to exhaust them, and the result would be that every fresh case that occurred would cause irresolution and uncertainty, and even lead to the man's doing the very opposite of what he ought to do."

From these extracts it will be seen that the work embraces an immensely wide field; and when it is remembered that the observations here put together are the result of the practical experience of one of the greatest cavalry soldiers of any age, it is allowable to hope that this latest publication of the Intelligence Department will be extensively read, and that its study will lead to as important results with us as it has produced throughout the whole of the Continental cavalry.—C. W. B. B.

Minas Hidraulicas Defensivas. Par el Colonel de Ingenieros D. LEOPOLDO SCHIED-NAGEL. Madrid. 1880.

THIS work deals fully with the question of submarine mining, and in many respects contains useful information.

The first part contains chapters on electricity as applied in the ignition of mines, conductors, fuzes, simultaneous explosions, explosive compounds, and charges. The second part has chapters on mine-cases, circuit-closers, testing apparatus, testing, different systems of submarine mines, electric light and telegraphy, general recapitulation. Part III deals with offensive torpedoes.

Although, as stated in the preface, this work has been compiled from a collected mass of information, and does not profess to impart much novelty to the subject, all interested in torpedo warfare cannot fail to derive some benefit from a perusal of this extensive volume. It is a pity, however, that the illustrations should have been published separately, as it renders reference to them inconvenient.—J. C. W.

General Aide-Memoires and Pocket-Books of Reference:—

1. *The Officer's Memorandum Book for Peace and War.* Compiled by Colonel R. HARRISON, C.B. Third edition. London: Kegan Paul and Co. 1881. Price 2s. 6d. Size $4\frac{1}{2}'' \times 3\frac{1}{4}'' \times \frac{1}{2}''$. Pp. 140. Weight under 8 ozs.
2. *The Scout's Guide and Field Book.* By Captain DELAVOYE, 56th Regiment. London: Richardson and Co. 1880. Price 2s. 6d. Size $5'' \times 3\frac{1}{4}'' \times \frac{1}{2}''$. Pp. 95. Weight under 3 ozs.
3. *Reconnaissance Aide-Memoire. Field, Note, and Sketch Book.* Compiled and designed by Captain E. GUNTER, 59th Regiment. London: Waterlow and Sons. Price 5s., post free. Size $7\frac{1}{2}'' \times 4\frac{1}{4}'' \times \frac{3}{4}''$. Pp. 15, with sketch sheets and blank pages. Weight 12½ ozs.

THESE books in no way aim at supplanting the well-known and invaluable "Soldier's Pocket Book," by Sir G. Wolseley, a work which may be looked on as the father of the series of modern books of reference for field use. They are offshoots, not rivals, of their ancestor. Colonel Harrison and Captain Delavoye seek to supply books just suited for carriage in the pocket, and containing just so much data as appears,

in their opinion, likely to be wanted at any moment in the field. The works are well spoken of by Officers who have used them, and they are doubtless valuable adjuncts to Sir G. Wolseley's more comprehensive book. It would be impossible to find any standard of comparison by which to test the relative merits of the "Officer's Memorandum Book" and the "Scout's Guide."

Captain Gunter's book is of a rather different character. It aims at combining a sketch-book with notes for use in framing reports, and consequently it is furnished with some two dozen sheets ruled in squares of 50 or 100 yards side, according as the scale used is 3" or 6" to the mile. Between each two sketch pages are a couple of pages of thin paper for field notes or for reproduction of the sketch by means of the carbonic paper contained in one of the two pockets of the book. The book is well worth trial on service.—L. A. H.

1871

